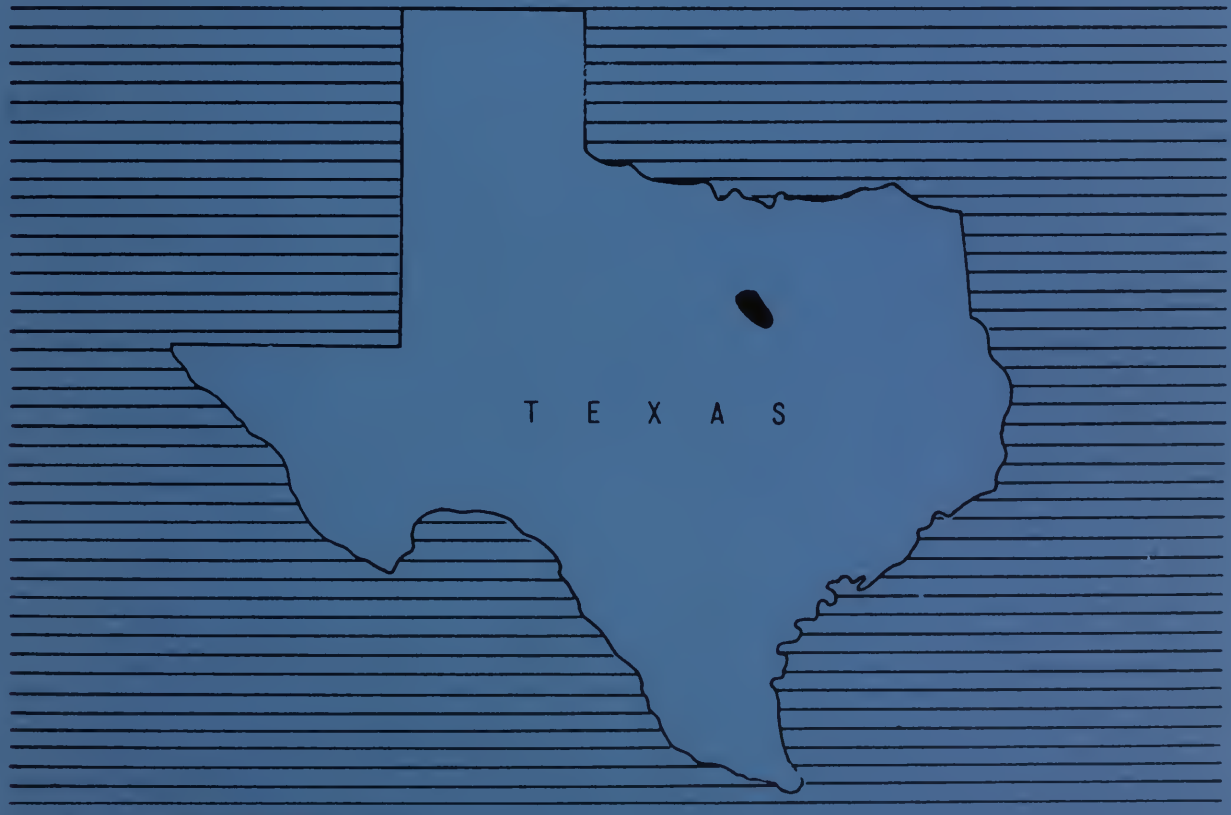
WORK PLAN

FOR WATERSHED PROTECTION, FLOOD PREVENTION AND AGRICULTURAL AND NON-AGRICULTURAL WATER MANAGEMENT

PALUXY RIVER WATERSHED

ERATH, HOOD, AND SOMERVELL COUNTIES, TEXAS



January 1972

4-30004 REV. 3-72
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4-30004 10-72

WATERSHED WORK PLAN AGREEMENT

between the

Bosque Soil and Water Conservation District
Local Organization

Hood-Parker Soil and Water Conservation District
Local Organization

Erath County Commissioners Court
Local Organization

Hood County Commissioners Court
Local Organization

Somervell County Commissioners Court
Local Organization

City of Glen Rose
Local Organization

(hereinafter referred to as the Sponsoring Local Organization)

State of Texas

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Paluxy River Watershed, State of Texas, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Paluxy River Watershed, State of Texas, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about 8 years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire without cost to the Federal Government such land rights as will be needed in connection with the works of improvement. (Estimated cost $ 408,951 .)

2. The Sponsoring Local Organization will provide relocation advisory assistance services and make relocation payments to displaced persons as required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. Prior to July 1, 1972, the Sponsoring Local Organization will comply with the real property acquisition policies contained in said Act and Regulations to the extent that they are legally able to do so in accordance with their State Law. After July 1, 1972, the real property acquisition policies contained in said Act shall be followed in all cases.

   The Service will bear 100 percent of the first $25,000 of relocation payment costs for any person, business, or farm operation displaced prior to July 1, 1972. Any such costs for a single dislocation in excess of $25,000 and all costs for relocation payments for persons displaced after July 1, 1972, will be shared by the Sponsoring Local Organization and the Service as follows:

	Sponsoring Local Organization (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	39.68	60.32	0 1/

1/ Investigations have disclosed that under current conditions the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentages shown above.

3. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement. (Estimated cost $2,000 .)

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Floodwater Retarding Structures	-	100.00	2,697,762
Multiple-Purpose Structure No. 16	6.82	93.18	112,560
Floodwater Retarding Structure No. 17	6.27	93.73	218,999
Multiple-Purpose Structure No. 26	14.72	85.28	383,772
Diversion Works	100.00	-	3,000

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Engineering Cost (dollars)
Floodwater Retarding Structures	-	100.00	158,252
Floodwater Retarding Structure No. 16	6.82	93.18	6,754
Floodwater Retarding Structure No. 17	6.27	93.73	10,950
Multiple-Purpose Structure No. 26	14.72	85.28	19,189
Diversion Works	100.00	-	354

6. The Sponsoring Local Organization and the Service will each bear the costs of Project Administration which it incurs, estimated to be $13,500 and $549,310, respectively.

7. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

8. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

    Separate agreements will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.
16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

Bosque Soil and Water Conservation District
Local Organization

By J. W. Hardcastle
J. W. Hardcastle

Title Chairman

Address Meridian, Texas 76665
Zip Code

Date May 24, 1972

The signing of this agreement was authorized by a resolution of the governing body of the Bosque Soil and Water Conservation District
Local Organization

adopted at a meeting held on April 13, 1972

James Watson
(Secretary, Local Organization)
James Watson

Address Bluff Dale, Texas 76043
Zip Code

Date May 24, 1972

Hood-Parker Soil and Water Conservation District
Local Organization

By Doyle Hutcheson

Title Chairman

Address P.O.Box 298, Weatherford, Texas 76086
Zip Code

Date May 24, 1972

The signing of this agreement was authorized by a resolution of the governing body of the Hood-Parker Soil and Water Conservation District
Local Organization

adopted at a meeting held on May 24, 1972

(Secretary, Local Organization)

Address Granbury, Texas 76048
Zip Code

Date May 24, 1972

Erath County Commissioners Court
Local Organization

By L. L. Martin

Title County Judge

Address Stephenville, Texas 76401
Zip Code

Date May 24, 1972

The signing of this agreement was authorized by a resolution of the governing body of the Erath County Commissioners Court
Local Organization

adopted at a meeting held on May 24, 1972

(Secretary, Local Organization)
Luther Pack, Commissioner

Address Stephenville, Texas 76401
Zip Code

Date May 24, 1972

Hood County Commissioners Court
Local Organization

By Milton Meyer
Milton Meyer
Title County Judge

Address Granbury, Texas 76048
Zip Code

Date May 24, 1972

The signing of this agreement was authorized by a resolution of the governing body of the Hood County Commissioners Court
Local Organization
adopted at a meeting held on May 8, 1972

Joe Swain
(~~Secretary, Local Organization~~) Commissioner
Joe Swain

Address Granbury, Texas 76048
Zip Code

Date May 24, 1972

Somervell County Commissioners Court
Local Organization

By Matt Teague
Matt Teague
Title Acting County Judge

Address Glen Rose, Texas 76043
Zip Code

Date May 24, 1972

The signing of this agreement was authorized by a resolution of the governing body of the Somervell County Commissioners Court
Local Organization
adopted at a meeting held on May 8, 1972

Oran D. Page
(~~Secretary, Local Organization~~) Commissioner
Oran D. Page

Address Glen Rose, Texas 76043
Zip Code

Date May 24, 1972

City of Glen Rose
Local Organization

By Eugene G. Connally
Eugene G. Connally

Title Mayor

Address Glen Rose, Texas 76043
Zip Code

Date May 24, 1972

The signing of this agreement was authorized by a resolution of the governing body of the City of Glen Rose
Local Organization

adopted at a meeting held on May 24, 1972

Thurmond R. Spencer
Thurmond R. Spencer, City Councilman

Address Glen Rose, Texas 76043
Zip Code

Date May 24, 1972

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Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

By _____

Date _____

WORK PLAN

FOR

WATERSHED PROTECTION, FLOOD PREVENTION

AND

AGRICULTURAL AND NON-AGRICULTURAL WATER MANAGEMENT

PALUXY RIVER WATERSHED
Erath, Hood, and Somervell Counties, Texas

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act, (Public Law 566, 83rd Congress, 68 Stat. 666), as amended.

Prepared By:

Bosque Soil and Water Conservation District

Hood-Parker Soil and Water Conservation District

Erath County Commissioners Court

Hood County Commissioners Court

Somervell County Commissioners Court

City of Glen Rose

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service
January 1972

4-30004

WATERSHED WORK PLAN

PALUXY RIVER WATERSHED
Erath, Hood, and Somervell Counties, Texas
January 1972

SUMMARY OF PLAN

General Summary

The work plan for watershed protection and flood prevention for the Paluxy River watershed, flood prevention and municipal water supply for the city of Glen Rose, and irrigation water supply for individual landowners was prepared by the Bosque and the Hood-Parker Soil and Water Conservation Districts, the Erath, Hood, and Somervell Counties Commissioners Courts, and the City of Glen Rose. The Paluxy River Watershed Association, although not an official sponsor, has been instrumental in developing local interest in the watershed, has helped in preparing the application for planning assistance, and has helped coordinate the efforts of local sponsors in order that planning may be accomplished in an efficient manner. Technical assistance was provided by the Soil Conservation Service of the U. S. Department of Agriculture. The Bureau of Sport Fisheries and Wildlife of the U. S. Department of the Interior collaborated with the Texas Parks and Wildlife Department in the preparation of a reconnaissance report on the fish and wildlife aspects of the watershed. Financial assistance for development of the work plan was provided by the Texas State Soil and Water Conservation Board and the Soil Conservation Service. Office space was furnished the work plan staff by the sponsoring organizations.

Paluxy River watershed, comprising an area of 390.5 square miles (249,920 acres), is located in the north portion of Erath County, the south portion of Hood County, and the north part of Somervell County. Approximately 10 percent of the watershed is cropland, 12 percent is pasture, 76 percent is rangeland, and 2 percent is in miscellaneous uses such as roads, cities, farmsteads, and parks. There is no federal land in the watershed.

The principal problems in and immediately below the watershed are frequent damages from floodwater, sediment, and scour which occur on about 17,500 acres of flood plain, of which 16,854 acres are highly productive agricultural land, 230 acres are Dinosaur Valley State Park land, and 416 acres are urban land within Glen Rose.

The estimated average annual floodwater, sediment, erosion, and indirect damages within the benefited area and without the project total $397,793.

Project objectives are the proper use, treatment, and management of the watershed's soil and water resources, the protection of the flood plain

4-30004 10-72

lands and property, both within and immediately below the watershed, and the stimulation of the economic development of the area as the result of project installation. The project, as formulated, meets these objectives.

The work plan proposes the installation, during an 8-year period, of a project for the protection and development of the watershed at a total cost of $7,100,769. The share of the cost to be borne by Public Law 566 funds is $4,174,321. The share to be borne by other than Public Law 566 funds is $2,926,448. In addition, the local interests will bear the entire cost of operation and maintenance.

Land Treatment Measures

Landowners and operators will establish and maintain needed land treatment measures on 9,380 acres of cropland and 45,899 acres of grassland at an accelerated rate during the 8-year installation period in addition to the maintenance of those measures already applied. These measures will improve the hydrologic condition of both cropland and grassland. This improvement in soil condition and cover will reduce sediment delivery to floodwater retarding structures and will effect some reduction in flooding. The installation cost of these land treatment measures is estimated to be $2,521,416, of which $2,416,771 will be from funds other than Public Law 566. Public Law 566 funds will provide about $104,645 in order to accelerate technical assistance needed for the planning, application, and maintenance of these measures. Of this amount, $6,688 will be used for the completion of needed soil surveys during the first two years of project installation.

Structural Measures

The structural measures included in this plan consist of 23 floodwater retarding structures, 1 structure having both floodwater and municipal water storage, and 2 structures having both floodwater and irrigation water storage. The estimated total cost of structural measures is $4,579,353, of which the local share is $509,677, and the Public Law 566 share is $4,069,676. The local share of the cost consists of land rights, water rights, construction costs allocated to municipal water and irrigation storage, engineering costs, and project administration.

Benefits

The installation of structural measures included in this plan will benefit directly the owners and operators of about 125 farms and ranches, as well as the owners and occupants of about 65 homes and the owners and operators of about 60 business establishments in Glen Rose, through a reduction in floodwater damages. In addition, the Glen Lake Methodist Camp and the Dinosaur Valley State Park will benefit directly by reduction in flooding. The municipal water supply, included in the plan as a supplement to the existing supply, will assure an adequate water supply for the projected foreseeable growth of Glen Rose. About 16,900 acres of flood plain land

will receive flood protection benefits. About 575 farms and ranches will benefit from the application of land treatment measures.

Damages within the benefited area after project installation will be reduced from an average of $397,793 annually to $69,622, or 82 percent. In addition to the damage reduction benefits, it is expected that incidental recreation benefits from the use of sediment pools of floodwater retarding structures will average $7,100 annually. Benefits from more intensive use of the flood plain as the result of reduced flooding should accrue at the average annual rate of $13,570. Benefits resulting from the inclusion of municipal water storage in one of the structures are expected to average $11,190 annually to the citizens of Glen Rose. The storage and use of irrigation water in two structures are expected to produce an average of $6,041 in annual benefits. The average annual primary benefits accruing to structural measures are estimated to be $355,851. Secondary benefits will amount to $71,700. The ratio of total annual benefits ($427,551) resulting from the installation of structural measures to the annual cost ($256,655) is 1.7 to 1.0.

Provisions for Financing Local Share of Installation Cost

Funds derived from existing tax sources for the local share of the cost of installing structures Nos. 1 through 25 will be provided by the commissioners court of the county in which the structural measure is located, except for the installation costs of multiple-purpose structures Nos. 16 and 17 allocated to irrigation water supply. These costs will be paid by the landowners involved through the appropriate county commissioners court.

The city of Glen Rose will pay for the local share of constructing multiple-purpose structure No. 26 and will need to approve a bond issue to finance its share of the cost.

Operation and Maintenance

Land treatment measures for watershed protection will be maintained by landowners or operators of the farms or ranches upon which the measures will be installed under agreements with the Bosque and the Hood-Parker Soil and Water Conservation Districts. The structural measures will be operated and maintained by the commissioners court of the county in which the structure is located except for the diversion works of multiple-purpose structure No. 26, which will be operated and maintained by the city of Glen Rose.

The estimated average annual cost of operation and maintenance is $3,600.

4-30004 10-72

DESCRIPTION OF THE WATERSHED

Physical Data

The Paluxy River watershed lies in the Brazos River basin and drains portions of Erath, Hood, and Somervell Counties, Texas (figure 3).

The Paluxy River heads in northern Erath County about 10 miles north of Stephenville. It flows southeastward across southern Hood County and into the northern part of Somervell County. The project area ends about 3 miles west of the city of Glen Rose. The Paluxy River, however, continues through Glen Rose and joins the Brazos River about 2 miles east of Glen Rose. Important tributaries lying in the Erath County portion include Pony, Sycamore, Richardson, Straight, Rough, Counts, Bee-Dee, Hightower, and Berrys Creeks and the South Paluxy River. Large tributaries in the Hood County portion include Wolf and Prairie Creeks and Windmill and Goss Hollows. The major tributaries in the Somervell County portion include White Bluff Creek and Bowden Branch. Most of these tributaries flow intermittently; however, the Paluxy River and short reaches of the largest tributaries are fed by permanent spring flow.

The total drainage area of the watershed is 390.5 square miles, or 249,920 acres.

The watershed is underlain by sedimentary rocks of Lower Cretaceous age. These rocks consist of poorly cemented sandstone, moderately hard to hard limestone, and soft shale. The beds have a regional dip of 40 to 50 feet per mile to the southeast. The topography ranges from gently rolling on the sandstone and shale outcrops to steeply rolling on the limestone outcrops. Elevations above mean sea level range from about 650 feet on the flood plain in the lowest reach to 1,500 feet in the headwaters.

Poorly cemented sandstone and soft shale of the Twin Mountains Formation crop out in the upper valley area surrounding the Morgan Mill and Bluff Dale communities. These rocks are covered by the alluvial flood plain soils on the mainstem and rocks of younger formations in the valley downstream from Bluff Dale. The sandstone of this formation is a source of permanent spring flow in the streams of the watershed. It is also an important ground water aquifer in central Texas downdip from the outcrop.

Moderately hard to hard limestone and soft calcareous shale of the Glen Rose Formation lie above the Twin Mountains Formation. These rocks crop out along and near the watershed divide in the northern part and over most of the central and lower parts. Rocks of this formation contain the three types of dinosaur tracks which are exposed in the lower reaches of the Paluxy River and in the Dinosaur Valley State Park near Glen Rose.

The Paluxy Formation is made up of sandstone similar to the Twin Mountains Formation. It crops out in a relatively narrow band on the northeastern,

northern, and western watershed divide and slightly below the southern watershed divide.

The southern watershed divide is underlain by several formations of the Fredericksburg Group. A gently rolling prairie occurs on soft calcareous shale and interbedded thin beds of hard fossiliferous limestone of the Walnut Formation. Prominent escarped mesa-like hills on the watershed divide are made up of soft limestone of the Comanche Peak Formation and are capped by hard, erosion-resistant limestone of the Edwards Formation.

Quaternary age terrace and alluvial deposits occur in the valleys of the mainstem and the major tributaries. The widths of these deposits range from 2,600 feet on the mainstem to less than 200 feet near the headwaters.

The watershed lies within two land resource areas: the Grand Prairie and the Cross Timbers. The Grand Prairie Land Resource Area occurs on the limestone and shale bedrock and comprises about 75 percent of the watershed. The soils of this area are generally shallow, gravelly to stony, calcareous, and fine-textured. They are mainly of the Malaterre, Purves, and Dugout series, with minor areas of the Denton, Houston Black, and Brackett series. The main use is for rangeland with small areas of deeper soils used for cropland. Soils of the Cross Timbers Land Resource Area occur on the sandstone bedrock outcrop. These soils are deep, medium to coarse textured, and neutral to slightly acid in reaction. The major soil series include the Windthorst, Nimrod, Duffau, and Selden. These highly erosive soils were extensively cultivated in the past but large areas have now been converted to grassland.

The alluvial flood plain soils have been derived mainly from the Grand Prairie. These highly productive, nearly level soils are dark-colored, calcareous clay loams and loams. The major series include the Frio and Bosque. They are used for cultivation, improved pasture, and pecan production.

A recognizable first and second bottom flood plain occurs on the mainstem from the vicinity of Morgan Mill in the upper reach to the downstream reach near Dinosaur Valley State Park. The first bottom is narrow and poorly developed in the upper reach of the mainstem from Morgan Mill to Bluff Dale and on the South Paluxy River. Maximum development, with widths ranging from 400 to 1,000 feet, occurs downstream from the vicinity of Bluff Dale to the vicinity of the Hood and Somervell county line.

The over-all projected land use in the watershed at end of project installation period is as follows:

Land Use	Acres	Percent
Cropland	26,085	10
Rangeland	188,721	76
Pasture	31,234	12
Miscellaneous 1/	3,880	2
Total	249,920	100

1/ Roads, railroads, farmsteads, villages, and state park.

4-30004 10-72

The average annual rainfall is about 30 inches. The months of April and May normally receive the greatest amounts; however, rainfall is fairly well distributed throughout the year. The January average temperature is 45° Fahrenheit and the July average temperature is 84° Fahrenheit.

The average date of the last killing frost in the spring is March 25 and that of the first killing frost in the fall is November 12, resulting in an average growing season of 232 days.

There is no known oil, gas, or other mineral production in the watershed. The X-Ray Gas Field, scattered oil and gas wells, and an area which formerly produced coal lie to the northwest of the watershed. Limestone gravel, occurring in terrace deposits along the Paluxy River and the larger tributaries, is used locally for road construction. Minor amounts of limestone and other calcareous deposits are also used locally.

There are no known historic or archeological sites within the watershed listed in, or in the process of nomination to, the National Register of Historic Places. Archeologists from the State Building Commission and Southern Methodist University made a brief cooperative reconnaissance survey of some of the floodwater retarding structure sites and did not find any archeological sites of scientific value. However, extensive archeological sites occur on the Brazos River and on its tributaries near the project area, suggesting that archeological sites could also occur in the Paluxy River watershed.

Economic Data

The economy of the watershed depends almost entirely upon agriculture. The farm income for the watershed is derived about equally from the sale of livestock and their products and crops.

There are about 575 farms and ranches, averaging about 435 acres, either wholly or partially within the watershed. About 490 of these are family-type units employing less than 1½ man-years of outside labor. About 85 are small low-income-producing units whose operators work off the farm in order to maintain an acceptable standard of living. It is estimated that about half of the total farm operators work off the farm. This varies from full-time employment to a day or so a week or seasonal employment such as custom harvesting of crops or feeding of livestock.

The small town of Bluff Dale and the communities of Paluxy and Morgan Mill are located in the watershed. The cities of Stephenville, with a population in 1970 of 9,277, located from 3 to 4 miles outside the southwestern boundary of the watershed, and Glen Rose, population in 1970 of 1,554, located on the Paluxy River about 3 miles below the watershed boundary, are the main marketing centers for watershed residents. These cities offer good

4-30004 10-72

schools, churches, hospitals, services, and supplies. About 115 miles of paved highways and 147 miles of all-weather roads link the watershed with other population and marketing centers in all directions. Railway service is also available to the east and west.

Land Treatment Data

The Bosque Soil and Water Conservation District, with technical assistance from Soil Conservation Service personnel headquartered at Stephenville and Glen Rose, and the Hood-Parker Soil and Water Conservation District, with technical assistance from Soil Conservation Service personnel headquartered at Granbury, Texas, have aided landowners and operators of watershed lands in the development of basic soil and water conservation plans and the application of needed land treatment measures.

The Bosque Soil and Water Conservation District was organized in 1941 and the Hood-Parker Soil and Water Conservation District was organized a short time later.

Basic soil and water conservation plans have been developed on 338 of the 575 operating units wholly or partially within the watershed. This represents 77 percent of the total agricultural land.

The Rural Environmental Assistance Program administered by the Agricultural Stabilization and Conservation Service has provided financial assistance, on a cost-sharing basis, for the application of land treatment measures.

It is estimated that needed land treatment has been applied on about 55 percent of the agricultural land in the watershed. Table 1A lists those measures and their amounts which have been applied. The total cost of this application is estimated at $2,707,742.

Fish and Wildlife Resource Data

The fish and wildlife habitat, species and populations in the watershed are described by the Bureau of Sport Fisheries and Wildlife as follows:

> Fish habitat in the watershed is limited to the Paluxy River, short spring-fed reaches in some tributaries, permanent pools in the intermittent creeks, farm ponds, and four small private reservoirs.
>
> The principal fish species in the watershed are largemouth bass, bluegill, redear and green sunfish, channel and flathead catfish, gizzard shad, carp, smallmouth buffalo, river carpsucker, and the gray redhorse. The only public fishing access to the river in the watershed is at highway crossings. There is some fishing by landowners and their friends on private property. The State of Texas is buying

land for a State park along the Paluxy River at the lower end of the project area to preserve the dinosaur tracks found there. Initially, the park will open one mile of the river to public fishing. Later, land acquisition will expand the fishing access to 3.6 river miles.

. . . . . .

Important game animals in the watershed are white-tailed deer, bobwhite, and mourning dove. Other wildlife species present include fox squirrel, cottontail, opossum, raccoon, gray fox, bobcat, coyote, ring-tailed cat, and skunk. Low numbers of waterfowl are found in the project area during spring and fall migration.

The golden-cheeked warbler occurs in the watershed. It is listed by the Bureau of Sport Fisheries and Wildlife as a rare species in their Resource Publication 34, Rare and Endangered Fish and Wildlife of the United States, dated July 1966. That bird requires the bark of virgin Ashe juniper trees for nest material and obtains its food from the juniper-oak association. About 4,000 acres of the virgin Ashe juniper grow at the southern edge of the watershed. . . .

(Figure 3 shows the approximate location of the virgin Ashe junipers used by golden-cheeked warblers for nest material).

The deer population is low throughout the watershed and hunting for deer is light to moderate. Most deer hunting is done on a lease basis.

Squirrel numbers are moderate along the stream and low elsewhere. These animals receive some hunting. Quail are found in low to moderate numbers in the project area and hunting for them is moderate to heavy. Mourning doves are present in moderate numbers in most of the watershed, and there is much interest in hunting them. Little duck hunting is done in the watershed because of low populations. There is some interest in sport hunting for raccoons, bobcats, foxes, and coyotes. A few raccoons are trapped for their fur.

Without the project, future wildlife densities and the amount of hunting would be expected to increase slightly due to improved game management techniques and increasing hunter demand.

WATERSHED PROBLEMS

Floodwater Damage

The principal problems in and immediately below the watershed are frequent damages from floodwater, sediment, and scour which occur on about 17,500 acres of flood plain, of which 16,854 acres are highly productive agricultural land, 230 acres are Dinosaur Valley State Park land, and 416 acres are urban land within Glen Rose. The agricultural flood plain lands are used as follows: sorghums for hay and grazing, 32 percent; small grain, 29 percent; improved pasture, 7 percent; pasture, 31 percent; and miscellaneous uses such as farmsteads and roads, 1 percent. Flood plain lands have a market value of $100 to $250 per acre, depending upon location and productivity. Acreages are those expected to be inundated by the 100-year frequency flood.

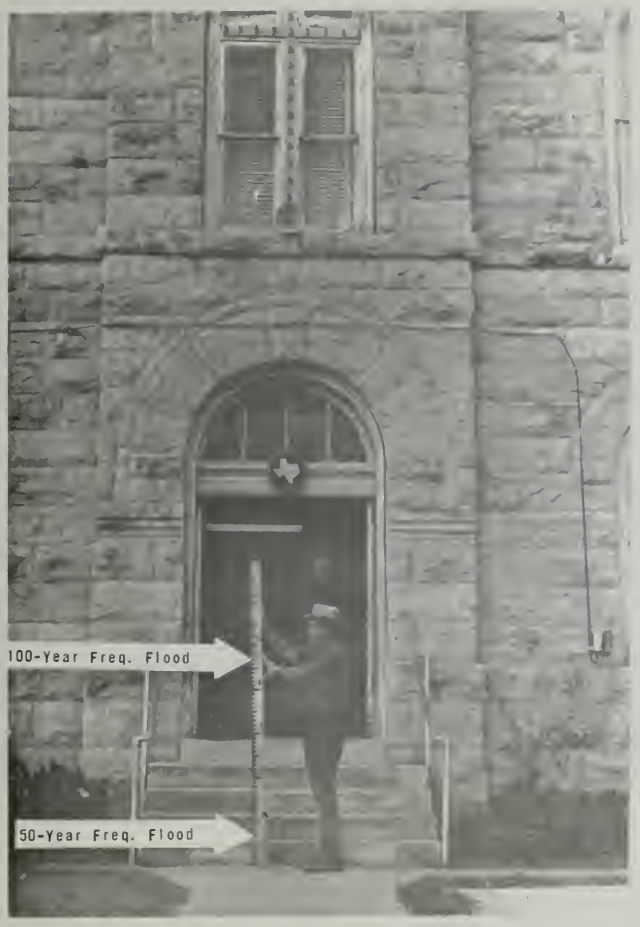
Figure 3 shows the flood plain that is subject to flood damage. The urban area of the city of Glen Rose that will be damaged by the 100-year frequency flood is shown in figure 4.

Serious floods during recent years include those of 1949, 1952, 1955, 1957, 1959, and 1963. The flood of October 1949, having an estimated 6.6 percent chance of occurrence, produced a peak discharge of 48,500 cubic feet per second at the stream gage on the Paluxy River near Glen Rose and inundated an estimated 12,800 acres of flood plain. The maximum flood of record, which occurred in April 1908, produced a peak discharge of 59,000 cubic feet per second at the same gage, flooded about 14,000 acres, and had a 4.6 percent chance of occurrence. It is estimated that the 1 percent chance of occurrence flood would inundate about 17,500 acres of flood plain, including the urban area of Glen Rose.

Damages to crops and pasture, other agricultural property such as fences, livestock, and other property, and to roads and bridges are quite extensive.

The Texas Parks and Wildlife Department is currently developing Dinosaur Valley State Park along the Paluxy River in the lower portion of the watershed. The completion date should coincide fairly closely with the completion of installation of this project for watershed protection and flood prevention. The park will encompass about 1,274 acres. About 230 acres of the park lie on the flood plain. The 1 percent chance of flood would be expected to inundate the interpretive complex area of the park to depths of more than 6 feet. This water would be swift and extremely destructive. Tracks of at least three species of dinosaurs, including sauropods, ornithopods, and theropods, have been preserved in the limestone along the river. These have attracted scientists and curious laymen from the four corners of the earth, in spite of the fact that serious deterioration has occurred as the result of flooding.

An interpretive complex will enable visitors to take an imaginary trip backward millions of years into the age of the dinosaur. This will be



The 100-year frequency flood will inundate a major part of the urban area of Glen Rose and cause damages estimated at $2,192,600. The arrows indicate the height that would be reached by the 50- and 100-year floods on the court house and the First National Bank building. The 100-year frequency flood will reach a height of 1.5 feet above the stadia board on the lower picture.

--Photos by the "Glen Rose Reporter"

4-30004

Average annual damages from floodwater are estimated to be $311,168.

Average annual damages to other agricultural property, such as fences, are estimated to be $31,882.

constructed on the flood plain and will attract countless thousands of visitors during the ensuing years. Several million dollars will be spent in park development.

Although a catastrophic flood has not occurred on the Paluxy River at Glen Rose since the city has been developed, such a threat exists. An analysis of hydrologic data indicates that the 1 percent chance flood would inundate a major part of the urban area of Glen Rose (figure 4), and would cause damages estimated at $2,192,600 based upon present development. About 60 businesses and 65 residences in the city of Glen Rose and 45 buildings at Glen Lake Methodist Camp are subject to flooding to depths of up to 9 feet. The flood of October 1949 was the last flood causing significant damage in Glen Rose. Damages were estimated at $100,000.

Under nonproject conditions the estimated average annual direct monetary damage by floodwater within the benefited area is $311,168. Of this amount, $68,606 is crop and pasture; $31,882, other agricultural; $49,520, road and bridge; $22,720, Dinosaur Valley State Park; and $138,440, urban damage in and near Glen Rose.

Indirect Damages

Indirect damages resulting from interruption of livestock feeding regimen and farming operations, re-routing of mail and school bus routes, dislocation of persons from homes and work, and losses to businesses are estimated at $55,320 annually.

Erosion Damage

Upland erosion in the watershed is moderate. The highly erosive Cross Timbers soils suffered severe sheet and gully erosion in the past. Erosion on these soils, as well as on the less erosive soils of the Grand Prairie, has been greatly reduced by land treatment, land conversion, and grassland management. The most serious erosion now is confined to scattered small areas of severely eroded land and shallow gullies which are healing.

Streambank erosion is destroying an average of 2.74 acres of land in the watershed annually. Most of this destruction is occurring on the mainstem channel lying within Hood County and extending into northern Somervell County. Small amounts occur on the tributaries and the upper reaches of the mainstem. Older residents of the watershed state that severe bank erosion and associated channel entrenchment began with the large flood of 1908. Channel entrenchment has progressed upstream into the headwaters area of all tributaries lying on soft bedrock. Natural revegetation is stabilizing the erosive channels in most upstream areas. However, active bank erosion remains a problem on the mainstem as the existing sharp meanders migrate downstream and the larger floods destroy most of the natural woody vegetation which develops along the waterline of the banks.

The average annual value of damage by streambank erosion is $9,273.

Flood plain scour damage in the watershed is moderate. Most of this damage occurs on second bottom flood plain, which is extensively cultivated. Little damage occurs in reaches where the first bottom is well developed. The damage is most severe in the reach between Morgan Mill and Bluff Dale. Large storms cause damage on an estimated 5,750 acres of flood plain soils through removal of topsoil by sheet scour on broad areas and deep scouring in narrow scour channels. Damages in reduced productivity of the soil range from 5 percent to 60 percent. The average annual value of damage by scouring is $10,799.

Sediment Damage

Sediment derived from the watershed causes overbank deposition damage to flood plain soils along the Paluxy River and downstream damages to Lake Whitney reservoir on the Brazos River.

Overbank deposition damage occurs mainly on the first bottom of the mainstem flood plain and to a lesser extent on the flood plain along the tributaries. Damaging materials consisting of gravelly sand, sand, and sandy loam are being deposited on about 2,090 acres of flood plain land. Damages in reduced fertility and productivity of the soil by these materials range from 10 to 40 percent. The average annual damage from overbank deposition on flood plain lands is $5,802.

An estimated average annual sediment load of 252,000 tons is delivered out of the watershed. The suspended portion of this sediment load represents a concentration of 2,200 parts per million in the average annual runoff. Deposition of suspended sediment, in addition to bed-load sediment derived from the watershed, results in an average annual depletion of 132 acre-feet of storage in Lake Whitney reservoir. The damage from this loss of storage space is estimated to average $5,431 annually.

Problems Relating to Water Management

Water for domestic and livestock use is obtained from wells and surface ponds. The communities of Morgan Mill and Bluff Dale, as well as the surrounding towns of Stephenville, Granbury, and Glen Rose, obtain their water from wells in the Twin Mountains Formation aquifer. This aquifer contains water of good quality with less than 500 parts per million total dissolved solids. However, the fine-grained sands of the aquifer restrict the rate of water movement and prevent development of high yielding wells. Aquifer conditions in the Morgan Mill area are unfavorable for development of a well or possibly a series of wells to adequately supply water needs for the community. The water supply for Glen Rose is adequate for present needs, but projected growth indicates the need for additional amounts in the future.

4-30004 10-72

The following table presents the projected population and average daily water needs as determined by the consulting engineer employed by the city:

Year	Population	Average Daily Use (1,000 gallons)
1970	1,554	155.4
1980	1,875	225.0
1990	2,250	315.0

The engineer employed by the city recommended that the city consider a surface water supply to meet its increased future water needs in lieu of expanding its pumping capacity.

Small amounts of ground water and surface water are being used to irrigate a limited acreage of improved pasture in the watershed. The quality of water from both sources is good and the soils are suitable for irrigation.

There is an interest in development of additional surface water supplies for supplemental irrigation of improved pasture.

Opportunities for water-based recreation are available at nearby Lakes Whitney and Granbury on the Brazos River, at floodwater retarding structures in nearby watersheds, and on the permanent flowing Paluxy River in the watershed. The development of Dinosaur Valley State Park on the Paluxy River will greatly increase recreation in this vicinity.

Other than sediment, there is no known source of pollution in the watershed.

PROJECTS OF OTHER AGENCIES

The Texas Parks and Wildlife Department has purchased land bordering the Paluxy River for development of a new state park. The main objective of the park will be the preservation and display of the dinosaur tracks along the river. The department is presently developing plans for the new park.

The project will benefit not only the developments planned for the park but will also help protect the tracks from damages caused by flooding. Many of the tracks have already been destroyed by floodwater.

The community of Morgan Mill has developed a water supply system with financial assistance from the Farmers Home Administration.

Lake Whitney, a multiple-purpose reservoir, is located on the Brazos River downstream from the confluence of the Paluxy River and the Brazos River. The reservoir provides flood protection to the Brazos River and water for generation of power. It also provides opportunities for water-based recreation to the area. The project will provide benefits by reducing the average annual rate of sediment deposition in the reservoir.

The Corps of Engineers is presently studying the feasibility of constructing a flood control dam across the Paluxy River. The proposed location is above where White Bluff Creek empties into the Paluxy River.

The portions of this watershed that are located in Erath and Somervell Counties are within Leon-Bosque Resource Conservation and Development project area. The development of the Paluxy River watershed is fully compatible with the objectives of the resource conservation and development plan for the area.

There are no other known projects of other agencies for water resource development which will affect or be affected by the works of improvement included in the plan.

BASIS FOR PROJECT FORMULATION

A reconnaissance and preliminary investigation of the watershed were made by representatives of the Soil Conservation Service and the sponsoring local organizations to determine the location and severity of watershed problems. A map was prepared to show the location of the areas being damaged by floodwater, erosion, and sediment. Meetings were held with the sponsors to discuss their problems, possible solutions, watershed resource development needs, and the formulation of project objectives. Initially the sponsors listed the following objectives:

1. The immediate establishment and maintenance of at least 80 percent of the needed land treatment measures which contribute directly to watershed protection.

2. Seventy to seventy-five percent reduction in floodwater, sediment, and erosion damages to the agricultural reaches.

3. Flood protection to the urban area of Glen Rose.

4. Reduction in flood damages to the paleontological treasures which are exposed in the lower reaches of the Paluxy River and possible development of a recreation area in the vicinity of the treasures.

5. Development of a multiple-purpose structure to include storage for municipal and recreational uses for the city of Glen Rose and municipal use for the unincorporated community of Morgan Mill.

6. Development of multiple-purpose structures to include irrigation water storage for two individual landowners.

7. Preservation and improvement of fish and wildlife resources.

8. Stimulation of the economic development of the area as the result of project installation.

It was agreed that the objectives were reasonable and consistent with watershed resource development. Possible ways to meet the objectives were then investigated.

Land treatment measures planned for the watershed are those which will contribute to watershed protection and preserve and improve the fish and wildlife resources.

Initially it was determined that land treatment measures would need to be supplemented with waterflow control measures in order to control the floodwater and reduce the damages.

Priority in the selection of waterflow control measures was given to those which had the greatest potential for providing an acceptable level of protection. Preliminary layouts were reviewed with the sponsors. Alternate locations were investigated as the need arose and comparisons were made to determine the most feasible system of structural measures.

The proposed project will meet the watershed protection and flood prevention objectives of the sponsors. Various systems of floodwater retarding structures were analyzed to determine a system which would economically accomplish the objectives. The final location, number, design, and cost of structural measures were determined by the physical, topographic, and geologic conditions in the watershed. Other influencing factors were improvements, land use, and the location of the damaged areas.

The community of Morgan Mill could not finance its share of the cost of a multiple-purpose structure to provide municipal water.

The city of Glen Rose, after considerable study, decided it could not finance its share of the cost of constructing a multiple-purpose structure to include storage for recreational use. It will include storage in Site 26 to provide a supplemental water supply.

Landowners on whose land structures Nos. 16 and 17 would be located requested that additional capacity for irrigation water be included in the structures.

Sites 17 and 18, on Richardson Creek, and Sites 20, 21, and 22, on Pony Creek, were planned in series because of the limited storage available at the lower site and the need for providing flood protection to the intervening area.

The Corps of Engineers is presently investigating the feasibility of constructing a dam on the Paluxy River for the purpose of flood control and conservation storage. The Corps project was not considered in place in formulating this project because of the uncertainty of the findings of the Corps investigations.

The Bureau of Sport Fisheries and Wildlife made a reconnaissance study of the watershed and made nine recommendations for the preservation and enhancement of fish and wildlife resources. The sponsoring local organizations and the Service considered these recommendations in formulating the land treatment and structural measures to be included in the work plan. After careful study, eight of the recommendations were determined to be highly desirable and feasible and seven were included in the land treatment and structural measures to be installed. The recommendation that "the sediment pool of floodwater retarding reservoirs be fenced, when practicable, and livestock water requirements be supplied by providing water lanes to the pools," was considered not feasible. Concentrating livestock into lanes down the slope to sediment pools causes bare trails to develop and accelerates erosion. Several lanes would be needed to each pool because of multiple ownership of land or divisions of grazing areas around sediment pools. Since the

sediment pools are located mainly in rangeland and cropland areas, livestock numbers will be relatively low. The sponsors feel livestock will not be watering in sufficient numbers to cause a significant pollution problem nor detract materially from the fish and wildlife benefits to be derived from the pool areas of floodwater retarding structures. Therefore, action to implement this recommendation is not considered warranted. The recommendation that landowners form a hunting and fishing cooperative is a project proposal of the Leon-Bosque Resource Conservation and Development project within which most of the watershed is located.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The use of each acre of land within its capabilities and its treatment in accordance with its needs has long been accepted as one of the foundations for the building of a strong and free community, state, or nation. Sponsors of this project are keenly aware of this concept and deem the installation and maintenance of needed land treatment measures as essential.

Land treatment measures planned for the watershed are those that will contribute directly to the preservation and enhancement of the environment in the watershed. Emphasis will be given to those measures which will reduce soil and water losses, assure proper functioning of the structural measures, reduce flooding, and preserve and improve the fish and wildlife resources of the watershed.

Soil surveys will be completed during the first 2 years of project installation; therefore, the planning and application of needed land treatment measures should proceed without interruption and on schedule.

In addition to effectively maintaining those land treatment measures already established (table 1A), it is planned to establish or complete the installation of the needed land treatment measures on about 9,380 acres of cropland and 45,899 acres of grassland (table 1). About 4,000 acres of the grassland will receive treatment for upland wildlife habitat management.

Conservation measures to be applied on cropland include conservation cropping system, crop residue management, diversions, terraces, and waterways in combinations necessary to provide adequate treatment. Conservation cropping systems primarily include strip cropping and crop rotation of small grain with and without legumes, grain sorghums, and forage sorghums.

Conservation measures which will be applied on pastureland include pasture and hayland planting and pasture and hayland management. Rangeland will be deferred and grazed properly. Invading brush will be controlled. Ranch operators planning brush control will be encouraged to accomplish this in a manner which will be compatible with the needs of wildlife for food, cover, and concealment in diurnal movement. Ranch operators doing any brush control in the virgin juniper thickets at the south edge of the watershed will be encouraged to consult with the Texas Parks and Wildlife Department and

the soil and water conservation district so as to avoid eliminating the golden-cheeked warblers' nesting habitat. In addition to rough seeding an area having brush controlled, the seeding of barren areas of sediment pools and adjacent soils will be encouraged to retard erosion and sedimentation and increase fertility in the impoundments. Farm ponds will be constructed to enable operators to defer grazing and use rangeland properly.

Land treatment measures planned to primarily benefit the fish and wildlife resources in the watershed are wildlife upland habitat management and fish pond management. Landowners will be encouraged to seek the advice of the Texas Parks and Wildlife Department in the management and stocking of their reservoirs for fish and the management of those waters for wildlife. Landowners will be encouraged to retain or create wildlife habitat and apply proper management to preserve and enhance the wildlife resources of the watershed. Upland wildlife habitat management will include such measures as planting small grains and/or legumes for food, retaining or planting areas of trees and shrubs along fence rows for wildlife food and cover, and doing any necessary brush control in such a manner that it is compatible with the needs of wildlife for food and cover.

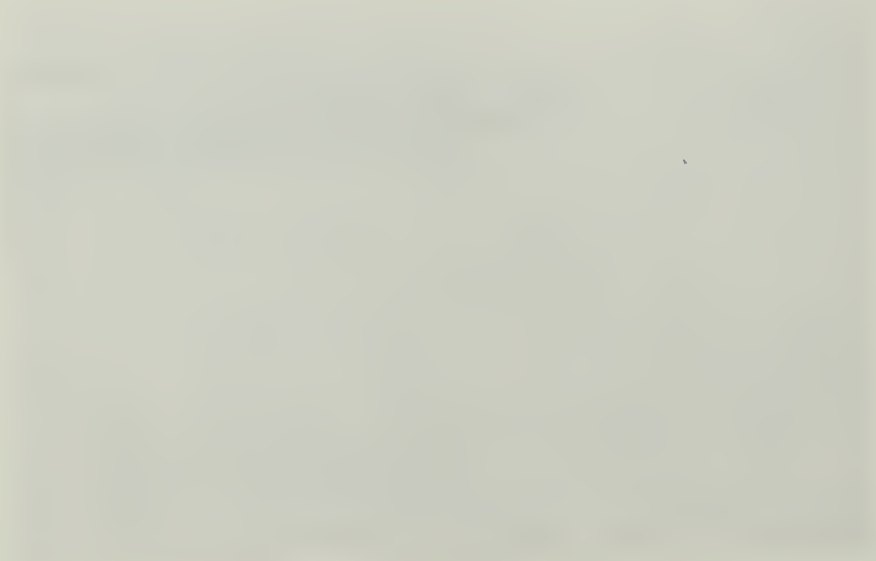
The application of these measures will improve both soil cover and condition. This improvement will reduce soil and water losses, will assure proper functioning of the floodwater retarding structures, will reduce flooding, will benefit the fish and wildlife resources of the watershed, and will help raise the income of operators of agricultural land.

Properly managed crop residues improve soil structure and fertility and enable the soil to absorb rainfall at a more rapid rate.

4-30004

Ponds not only furnish water for livestock but also provide fish habitat and water for wildlife. It is planned to install 204 ponds during the installation period.

Control of invading brush, when coupled with sound range management practices, results in high quality livestock forage and provides excellent protection to the watershed. Note the brush left for wildlife habitat.



The land treatment needs on the approximately 140 acres of state park lands which lie within the watershed boundary will consist primarily of upland wildlife habitat management and proper grazing use. The Texas Parks and Wildlife Department is currently developing plans for the park and are consulting with the soil and water conservation district and the Soil Conservation Service on a plan for proper grazing.

Structural Measures

A system of 23 floodwater retarding structures and 3 multiple-purpose structures will be installed to provide protection to the flood plain lands, muncipal water for the city of Glen Rose, and irrigation water supply for two individual landowners. The location of the planned structural measures is shown on the project map (figure 6).

Multiple-purpose structures Nos. 16 and 17 will have 96 and 326 acre-feet, respectively, of capacity included for storage of irrigation water.

Multiple-purpose structure No. 26 will have 700 acre-feet of capacity included for storage of municipal water for the city of Glen Rose.

Runoff from 219.18 square miles or 56 percent of the watershed will be retarded by the structural measures. The total storage capacity of the floodwater retarding and the multiple-purpose structures is 57,458 acre-feet, of which 7,360 acre-feet are for sediment storage, 48,976 acre-feet are for floodwater retarding storage, 422 acre-feet are for irrigation storage, and 700 acre-feet are for municipal water storage. The principal spillway crest elevation of all floodwater retarding structures will be set at the 100-year sediment capacity. The principal spillways for floodwater retarding structures Nos. 7, 13, 15, 18, 19, 20, 21, 22, 24, and 25 will be ported at the elevation of the 200 acre-foot capacity.

The principal spillway crest elevation for multiple-purpose structures Nos. 16 and 17 will be set at elevation 850.0 and 1035.2, respectively. These are the elevations of the 100-year submerged sediment capacity plus the capacity for irrigation storage. The principal spillway crest for multiple-purpose structure No. 26 will be set at elevation 741.5. This will provide capacity for the 100-year submerged sediment and municipal water storage. The principal spillway will be modified to serve as the diversion works. The preliminary plans are to release the water into the downstream channel and pick it up at a low-water dam in the vicinity of Glen Rose.

4-30004 10-72

All of the structures will have provisions to release impounded floodwater in order to perform maintenance, and if it becomes necessary, to avoid encroachment upon prior downstream water rights.

A combination of principal spillway capacity and retarding storage will assure that emergency spillways of floodwater retarding structures will have less than 4 percent chance of use at the end of their design life. The principal spillways will be the drop inlet type with cantilever outlets.

4-30004 10-72

All of the structure sites are located in sedimentary rocks of Lower Cretaceous age. The abutments and foundations of Sites 1 through 15 and the foundations of Sites 16, 17, 18, and 22 are located on soft, poorly cemented sandstone and soft sandy shale bedrock. Foundation conditions will vary from yielding in the soft sandy shale to firm on the poorly cemented sandstone. Deep cutoffs will be required at most sites to prevent excessive water movement through highly permeable gravels in the alluvium. Seepage will not be a problem in the sandy shale. Low rates of permeability are expected in the sandstone because of the fine-grained sands. Seepage through beds exposed in steep abutments may be a problem at Sites 4, 6, 7, 8, 12, 13, and 15. Borrow materials for construction of embankments at these sites are classified as SC, CL, GC, SM, GM, and GP, according to the Unified Classification System.

The abutments of Sites 16, 17, 18, and 22 and foundations and abutments of Sites 19, 20, 21, 23, 24, 25, and 26 are located on soft calcareous shale and soft-to-hard limestone bedrock. The limestone foundations are non-yielding. Some shaping of rock overhangs and bluffs will be necessary at several of these sites. Small volumes of rock excavation may also be required in the emergency spillways. The harder limestone will be adequate for use as riprap on the embankment. Borrow materials for construction of embankments are classified mainly as CL, GC, GM, and GP.

Due to high velocities associated with the emergency spillway design flow of Sites 18, 22, and 26, the type of vegetation to be established in the emergency spillways will be bermudagrass.

It will be necessary to modify portions of several utility lines in order to install floodwater retarding structures 2, 11, 18, and 22. A number of low-water crossings affected by the release flows from the floodwater retarding structures will be improved to make them passable during prolonged flows. All modifications, alterations, or replacements of fixed improvements are land rights costs and will be borne by the sponsors.

Preliminary investigations indicate that under present conditions installation of the structural measures will not cause the displacement or relocation of any dwelling, business, or farming operation.

A total of 4,105 acres of land will be required for the installation of the structural measures. The construction of the dams, emergency spillways, and the sediment and water supply pools will require 1,263 acres and the detention pools will require 2,842 acres. The dams, emergency spillways and areas disturbed during construction will be planted with multi-use plants for both erosion control and wildlife use.

A site-by-site inventory of land use, wildlife, and wildlife habitat conditions was made by Service biologists. Land use on the 1,263 acres needed for construction of the structural measures includes 155 acres of cropland, 101 acres of improved pasture, 445 acres of open rangeland, 327 acres of woody rangeland, and 235 acres (26 miles) of normally dry stream channels. Approximately 3 miles of this channel are in open land and 23 miles are in woods or have a woody canopy on the banks.

4-30004 10-72

Land use on the 2,842 acres of land subject to temporary inundation by the floodwater impounded in the detention pools includes 402 acres of cropland, 214 acres of improved pasture, 1,976 acres of open and brushy rangeland, and 250 acres (30 miles) of normally dry stream channels.

Figures 1, 2, and 2A show structures which are typical of those planned for this watershed. Table 3 shows details on quantities and design features.

All applicable state water laws will be complied with in the design and construction of the structural measures, as well as those pertaining to storage, maintenance of quality, and use of water. All state and local health requirements will be complied with in the installation, operation, and maintenance of multiple-purpose structure No. 26.

EXPLANATION OF INSTALLATION COSTS

Land treatment measures listed in table 1 will be applied by local interests at an estimated cost of $2,521,416. This includes funds for Public Law 46 and Public Law 566 technical assistance to be provided by the Soil Conservation Service and cost-sharing in the establishment of approved conservation measures under the Rural Environmental Assistance Program administered by the Agricultural Stabilization and Conservation Service. Included in the above sum is an estimated $104,645 of Public Law 566 funds to accelerate technical assistance in order that planning and application of needed land treatment measures included in this plan may be accomplished by the end of the 8-year installation period. The estimated cost for application of the various measures is based on current prices being paid by landowners and operators in the area.

The total installation cost of the structural measures is estimated to be $4,579,353. The Public Law 566 costs will be $4,069,676 and the local share will be $509,677.

The local cost includes $80,899 for construction, $408,951 for land rights, $13,500 for project administration, $2,000 for water rights, and $4,327 for engineering services. The estimated value of land rights includes $3,550 for legal fees, $396,251 for value of easements, and $9,150 for modification of utility lines and low-water crossings. The construction and engineering cost of modifying the principal spillway of multiple-purpose structure No. 26 to use it as a diversion works is a specific cost and is allocated to municipal water. The sponsors will bear the entire cost.

Construction and engineering costs for Sites 16, 17, and 26 were allocated by the "Use of Facilities Method," which distributes joint costs in proportion to capacity. The following tabulation shows the allocation of storage to purpose for these structures:

4-30004 10-72

ALLOCATION BY PURPOSE

Paluxy River Watershed, Texas

Structure No.	Flood Prevention		Municipal		Irrigation		Total	
	Acre-Feet	Percent	Acre-Feet	Percent	Acre-Feet	Percent	Acre-Feet	Percent
16	1,312	93.18	-	-	96	6.82	1,408	100.00
17	4,874	93.73	-	-	326	6.27	5,200	100.00
26	4,056	85.28	700	14.72	-	-	4,756	100.00

The construction cost includes the engineer's estimate and a 10 percent allowance for contingencies. The engineer's estimate was based on the unit cost of construction items needed for each structural measure. The unit cost for those items was based on actual cost of structural measures in similar areas modified to conditions found in this watershed.

Engineering and project administration costs are based on analysis of previous work in similar areas. Engineering costs consist of, but are not limited to, detailed surveys, geological investigations, laboratory reports, designs, and cartographic services. Project administration costs consist of construction inspection, contract administration, maintenance of Soil Conservation Service state office records and accounts, and Washington office and engineering and watershed planning unit costs.

Value of land, easements, and rights-of-way was estimated by representatives of the local sponsors and concurred in by the Soil Conservation Service. The estimated cost for moving or modifying the utility lines was furnished by the respective utility companies servicing these lines. The respective county commissioners courts furnished the estimated cost for modifying the low-water crossings.

The local costs for project administration include sponsors' cost related to contract administration, overhead and organizational administrative costs, and whatever construction inspection the sponsors desire to make at their own expense.

The estimated schedule of obligations for the 8-year installation period, covering installation of land treatment and structural measures, is as follows:

Schedule of Obligations

Fiscal Year	Measure	PL 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
1st	Land Treatment	15,588	302,096	317,684
2nd	Land Treatment	15,588	302,097	317,685
	Floodwater Retarding Structures 11, 12, and 19 and Multiple-Purpose Structure No. 17	584,499	79,635	664,134
3rd	Land Treatment	12,244	302,097	314,341
	Floodwater Retarding Structures 4, 6, 23, and 24 and Multiple-Purpose Structure No. 16	597,171	54,100	651,271
4th	Land Treatment	12,245	302,097	314,342
	Floodwater Retarding Structures 1, 2, 20, and 21	628,839	55,631	684,470
5th	Land Treatment	12,245	302,096	314,341
	Floodwater Retarding Structure 25 and Multiple-Purpose Structure No. 26	586,641	121,627	708,268
6th	Land Treatment	12,245	302,096	314,341
	Floodwater Retarding Structures 9, 10, 13, 14, 15	616,251	65,761	682,012
7th	Land Treatment	12,245	302,096	314,341
	Floodwater Retarding Structures 3, 5, 7, and 8	528,587	54,171	582,758
8th	Land Treatment	12,245	302,096	314,341
	Floodwater Retarding Structures 18 and 22	527,688	78,752	606,440
TOTAL		4,174,321	2,926,448	7,100,769

4-30004

EFFECTS OF WORKS OF IMPROVEMENT

The installation of project measures, both land treatment and structural, will achieve the project objectives of watershed protection, flood prevention, and agricultural and non-agricultural water management.

The application of the land treatment measures will help to improve the productivity of the soil by reducing erosion and improving the fertility and infiltration properties of the soil. The measures will also reduce downstream floodwater and associated damages by reducing erosion and the peak rate of runoff from the upland. The habitat for fish and wildlife will also be generally improved by making food and water supplies more dependable. Ponds installed for livestock water supply will also provide additional potential for developing fisheries.

The installation of structural measures included in this plan will benefit directly the owners and operators of about 125 farms and ranches, as well as the owners and occupants of about 65 homes and the owners and operators of about 60 business establishments in Glen Rose, through a reduction in floodwater damages. In addition, the Glen Lake Methodist Camp and the Dinosaur Valley State Park will benefit directly by the reduction in flooding. The municipal water supply, included in the plan as a supplement to the existing supply, will assure an adequate water supply for the projected foreseeable growth of Glen Rose.

About 16,900 acres of flood plain land will be protected by structural measures. Had the project been installed at the time of the October 1949 flood, only 4,800 acres would have been flooded. This is about 37 percent of the acreage estimated to have been inundated by that flood.

The following tabulation shows the reduction in average annual flooding by acres and percent for all agricultural evaluation reaches (figure 3):

Evaluation Reach	Without Project Acres	With Project Acres	Percent Reduction
1	418	117	72
2	963	418	57
3	73	27	63
4	1,046	540	48
5	638	224	65
6	193	47	76
7	82	13	84
9	134	29	78
10	30	3	90
11	258	120	53
12	210	6	97
13	235	83	65
14	350	3	99
15	21	21	-
16	155	2	99
17	38	0	100
18	5	0	100
19	17	2	88
20	6	0	100
21	25	0	100
All Agricultural Reaches	4,897	1,655	66

Average annual floodwater damages within the benefited area will be reduced by 84 percent. This includes crop and pasture, 72 percent; other agricultural, 70 percent; Dinosaur Valley State Park damage, 92 percent; Glen Rose urban damage, 96 percent; and road and bridge, 75 percent.

4-30004

Figure 4 shows the urban area of Glen Rose that will be inundated by the 100-year frequency flood under without and with project conditions. The proposed project will provide protection from the 100-year event to all existing urban properties except four houses located at an extremely low elevation on Grace Street, three houses on Bernard Street, and several low-lying cabins and improvements at the Glen Lake Methodist Camp. The average depth in the homes subject to flooding from the 100-year frequency event is 1.7 feet on Grace Street and less than 0.5 foot on Bernard Street. With the project installed, damages to these homes would still be experienced from only those floods exceeding an expected 50-year frequency. Some damage will still be experienced to facilities at the Glen Lake Methodist Camp from floods exceeding those of an expected 25-year frequency, with significant damage occurring only from floods exceeding the 50-year frequency.

Additional structural works of improvement were considered but were of only minor significance in providing increased protection to these properties. It is not economically feasible to provide the 100-year level of flood-free protection for the properties still subject to damage.

Installation of the project will reduce the sediment load delivered from the watershed and deposited in Lake Whitney from an average of 132 acre-feet to 55 acre-feet annually, a reduction of 58 percent. The suspended sediment concentration carried by runoff water leaving the watershed will be reduced from 2,900 to 1,058 parts per million based on average annual runoff of 48,850 acre-feet under without project conditions and 46,780 acre-feet under with project conditions. Overbank deposition damage to the flood plain lands will be reduced by 48 percent.

Change in flood flow patterns and the related energy forces acting on the streambanks of the watershed after installation of the structural measures is expected to reduce streambank erosion damage to valuable pasture and bearing pecan trees by 64 percent. Scour damages to fertile flood plain soils will be reduced by 62 percent.

Floodwater damages expected to occur to Dinosaur Valley State Park will be reduced by 92 percent. An interpretive complex is planned for the 230 acres of flood plain in the park. This will depict life-sized dinosaurs and other creatures in their natural habitat as it existed here eons ago. Tracks of these prehistoric creatures will thrill both young and old alike as they take this imaginative trip back through the ages. This delightful excursion will also be educational. Many renowned explorers, scientists, and educators were first motivated by and owe their success to their first trip through a museum of natural history.

Without the project the 1 percent chance flood would be expected to inundate the interpretive complex area of the park to depths of more than 6 feet. This water would be swift and extremely destructive. With the project, this same flood would cover fewer acres, would be shallow, would have low velocities, and would do little damage.

Figure 4 shows the areal extent of flooding in the urban area of Glen Rose under both with and without project conditions. Figure 5 shows the depth of flooding at valley section 201 under the same conditions. This reduction of area flooded, depth, and velocities will reduce average annual damages by 96 percent.

4-30004 10-72

About 16,254 acres of valuable agricultural land will be protected from floodwater by structural measures.

Average annual damage by overbank deposition will be reduced by 48 percent. Average annual damage to other agricultural property, such as fences, will be reduced by 70 percent.

4-30004 10-72

The interpretive complex area to be constructed to display the dinosaur tracks such as these will be protected from flooding by the project. Flooding has damaged many of the tracks which are exposed in the river bed.

4-30004

The inclusion of storage capacity for municipal water in a multiple-purpose structure a few miles upstream from Glen Rose will further benefit the 1,544 residents of that city by providing a dependable yield of 363,000 gallons of good quality water per day. Townsmen and planners alike may look and plan confidently into the future, secure in the knowledge that there is little likelihood of their city being stymied by a shortage of good water. The water should require minimum treatment in order to meet health agency standards. Although detailed water quality data for the Paluxy River and its tributaries are not available, streams in this area normally have less than 300 parts per million of dissolved solids and a sediment concentration of about 3,000 p.p.m. The water will be moderately hard with the prevalent carbonates being calcium and magnesium. The firm yield of the reservoir will supply an average of 150 gallons per day per capita to a population of 2,420. This exceeds the foreseeable needs of Glen Rose slightly but will provide for an adequate margin of safety, which is necessary when planning for the water needs of a city.

Two structures will have provision for storage of supplemental irrigation water for irrigation of several hundred acres of improved pasture.

A maximum initial reduction in average annual runoff of 2,186 acre-feet is expected from the combined effects of evaporation losses from sediment and water supply pools and water use from the water supply pools of the multiple-purpose structures immediately after project installation. This will result in an initial reduction from 51,290 acre-feet to 49,104 acre-feet, or 4.3 percent, in average annual volume of streamflow at the USGS gage on the Paluxy River. Of this reduction, evaporation losses will initially amount to 3.2 percent. This initial water loss by evaporation will be reduced as sediment accumulates in the sediment pools over the life of the project. The average annual discharge of 1,210,000 acre-feet at the USGS gage on the Brazos River near Whitney, Texas, will be reduced less than two-tenths of one percent. This minor reduction in streamflow is not expected to have a significant effect on power generation at Lake Whitney. The quality of runoff from the Paluxy River is high and serves to dilute the more saline water of the Brazos River. The reduction in runoff is expected to have very little effect on the water quality of the Brazos River.

It is expected that about 1,500 acres of flood plain pasture will be managed more intensively. The reduction in flooding will enable operators to fertilize, control undesirable plants, and manage grazing more efficiently. This will help stabilize their income.

Installation of the project will require 1,028 acres of agricultural land and 235 acres (26 miles) of stream channel, having intermittent flow, for the construction of the dams and emergency spillways and for the area to be inundated by the sediment and water supply pools. The agricultural land includes 155 acres of cropland, 101 acres of pastureland, 445 acres of open rangeland, and 327 acres of wooded rangeland. It will be necessary to clear most of the woody cover on the 327 acres of wooded rangeland during construction. This clearing will result in the removal of the tree and brush canopy on the banks of about 14.4 miles of the 26 miles of normally dry stream channels which will also be affected by the installation of

4-30004 10-72

structural measures. The tree and brush canopy on the banks of 8.6 miles (77 acres) of channels in the upper reaches of the sediment and water supply pools will not be cleared or destroyed. The impoundment of permanent water in these deep, normally dry channels will greatly enhance the wildlife habitat on the adjoining woody and open rangeland. Revegetation of land cleared in the construction areas with multiple-use plants for both erosion control and wildlife use will help to offset the losses of woody vegetation destroyed by project installation.

The detention pools will require the use of 2,842 acres of land for the temporary impoundment of floodwater. The land use on this area includes 402 acres of cropland, 214 acres of improved pasture, 1,976 acres of open and brushy rangeland, and 250 acres (30 miles) of normally dry stream channels. It is expected that the 402 acres of cropland will be converted to grassland with the installation of the structures. The remaining land will remain in its present use with this use interrupted occasionally by floodwater. The productivity of the grassland and the composition of the natural vegetation throughout the detention pool areas is not expected to be altered significantly.

The pools of structures are expected to provide an estimated 15,500 visitor-days of incidental recreation resulting from swimming, camping, fishing, and picnicking by local inhabitants and visitors. Sponsors have given assurance that adequate sanitary facilities meeting state and local health standards will be provided prior to recreation use. Water quality will be satisfactory for all planned beneficial uses.

The sediment pools and water supply pools will create an additional 904 surface acres of water. This will add significantly to the sport fishing resources in the watershed and also enhance greatly the waterfowl habitat.

It is expected that there will be no deleterious effects upon the golden-cheeked warbler or its habitat as the result of project installation.

The installation of structural measures will have no adverse effect on, nor will they be affected by, any known mineral resources within the watershed.

A brief reconnaissance survey by archeologists was made on several of the proposed floodwater retarding structure sites included in the project. This survey indicated that no archeological sites of scientific value would be affected by these measures. There are no known archeological or historical sites either listed or nominated for the National Register of Historic Places, according to the State Historical Survey Committee, that will be affected by the installation of measures included in the project. Archeological studies on the Brazos River and nearby tributaries have disclosed the presence of valuable archeological sites and this evidence suggests that such sites may also occur on the Paluxy River. Most of such sites would be expected to occur along the mainstem of the Paluxy River, which is a permanent stream. It is possible, however, that these sites could also occur at some of the floodwater retarding structure sites not surveyed.

4-30004 10-72

All of the dinosaur tracks occur downstream from the structural measures and will receive flood protection from the measures included in the project.

The effects of works of improvement on fish and wildlife habitat are described by the Bureau of Sport Fisheries and Wildlife as follows:

> With the project, the structural measures and most land treatment measures generally would aid wildlife. The floodwater retarding reservoirs and farm ponds would provide some resting areas for waterfowl. Flood reduction below the reservoirs would improve reproduction for groundnesting birds. Land treatment measures such as conservation cropping systems, proper range use, and deferred grazing would be beneficial to big game and upland game. Stirring of the soils would stimulate weed growth and thus benefit seed-eating animals. However, increasing the density of grass cover in the project area would not be advantageous to doves and bobwhites. Indiscriminate brush control would be damaging to wildlife habitat in the watershed.

Secondary benefits will accrue to the trade area as a result of increased purchases from those supplying farm equipment, petroleum products, seeds, feeds, fertilizers, services, and other items needed by the family. The benefits from damage reduction will result in improved living standards for residents of the watershed and Glen Rose. This improvement will be reflected in local support of schools and churches, both so essential to the well-being of present and future generations. In addition to the aforementioned benefits, there are intangible benefits which will accrue. Residents will feel more secure knowing that the fruits of their labor and monetary investments are not so likely to be washed away at the whim of Mother Nature. They will also appreciate the fact that here is an excellent environment in which to rear their families. These benefits, although real and of utmost importance, have not been evaluated, nor have they been used for project justification.

PROJECT BENEFITS

The installation of all land treatment and structural measures in this watershed will produce the following benefits.

The estimated average annual monetary damage (table 5) will be reduced from $397,793 to $69,622, or 82 percent. Crop and pasture damages will be reduced from $68,606 to $19,548, or 72 percent. Other agricultural damage, such as loss of livestock, fences, farming equipment, etc., will be reduced from $31,882 to $9,609, or 70 percent. Damages to roads and bridges will be reduced from $49,520 to $12,190, or 75 percent. Damages to Dinosaur Valley State Park, expected to average $22,720 annually, will be reduced to $1,770, or 92 percent. Urban damages to the city of Glen Rose will be reduced from $138,440 to $5,610 or 96 percent. Overbank sediment deposition damages, now occurring at an average annual rate of $5,802, will be reduced to $3,000, or 48 percent. Damages caused by deposition in Lake

Whitney will also be reduced from $5,431 to $2,273, or 58 percent. Flood plain scour damages will be reduced from $10,799 to $4,137, or 62 percent. Streambank erosion damages will be reduced from $9,273 to $3,377, or 64 percent. Indirect damages will be reduced from $55,320 to $8,108, or 85 percent.

The storage of municipal water in one of the structures will result in $11,190 additional benefits to the city of Glen Rose.

Benefits from supplemental irrigation by use of water stored for that purpose in two structures are expected to average $6,041 annually.

The reduction in flooding will enable operators along the flood plain to intensify management of pastureland. It is expected that this will result in an average of $13,570 in benefits annually.

It is estimated that structural measures will produce average annual incidental recreation benefits of $7,100 through the use of sediment pools.

Although not considered pertinent from a national viewpoint, secondary benefits attributable to structural measures are expected to amount to $71,700 annually within the three county area in which the watershed is located.

COMPARISON OF BENEFITS AND COSTS

The total average annual cost of structural measures (amortized total installation cost plus operation and maintenance) is $256,655. These measures are expected to produce average annual primary benefits of $355,851. The benefit-cost ratio without secondary benefits is 1.4 to 1.0. The ratio of total annual project benefits accruing to structural measures, $427,551, to the average annual cost of structural measures, $256,655, is 1.7 to 1.0 (table 6).

4-30004 10-72

PROJECT INSTALLATION

The project installation period will be 8 years. The general sequence of installation is shown under the schedule of obligations, "Explanation of Installation Costs."

Planned land treatment (table 1) will be accomplished by farm and ranch operators in cooperation with the Bosque and the Hood-Parker Soil and Water Conservation Districts during the 8-year installation period.

The installation of land treatment measures which will benefit wildlife will be encouraged at every opportunity. Landowners will be encouraged to seek assistance from the Texas Parks and Wildlife Department in the management and stocking of their reservoirs and farm ponds for fish and wildlife and the management of the water bodies for wildlife.

The goal is the treatment of 9,380 additional acres of cropland and 45,899 additional acres of grassland by the end of the installation period.

The governing bodies of the soil and water conservation districts will assume aggressive leadership in acclerating the land treatment program now being applied.

The Soil Conservation Service will provide additional technical assistance to the soil and water conservation districts to accelerate the planning and application of soil, plant, and water conservation measures.

Public Law 566 funds will supplement Public Law 46 funds in order that soil surveys on 38,607 acres can be completed during the first two years.

The Agricultural Stabilization and Conservation Service will provide financial assistance for application of those measures which will accomplish the conservation objectives in the shortest possible time. The Extension Service will assist in the education phase of the program by holding local farm meetings, preparing press, radio and television releases, and using other methods of getting information to landowners and operators in the watershed. Soil and water conservation loans available through the Farmers Home Administration will be given special emphasis. Present FHA clients in the watershed will be encouraged to cooperate in the program.

The structural measures will be installed during the last 7 years of the 8-year installation period. Floodwater retarding structure No. 18 was designed considering multiple-purpose structure No. 17 in place. Floodwater retarding structure No. 22 was designed considering floodwater retarding structures No. 20 and No. 21 in place.

4-30004 10-72

Therefore, multiple-purpose structure No. 17 will be constructed prior to No. 18 and floodwater retarding structures Nos. 20 and 21 will be constructed prior to No. 22.

As required by Public Law 86-523, the Service will keep the Secretary of the Interior informed of the construction schedule so that the Secretary can cause a survey to be made of the sites to ascertain whether such sites contain historical and archeological data which should be preserved in the public interest. Further, if any archeological materials are found during construction, the Secretary will be similarly notified.

The commissioners courts and the city of Glen Rose have the right of eminent domain under applicable state laws and each has the financial resources necessary to fulfill its responsibilities.

The Erath County Commissioners Court is responsible for the installation of the structural measures located in Erath County. These are structures Nos. 1 through 14 and 17 through 21, and the dam, the emergency spillway, and portions of the reservoir area of structure No. 15.

The Hood County Commissioners Court is responsible for the installation of the structural measures located in Hood County. These are structures Nos. 16, 22, and 24 and portions of the reservoir area of structure No. 15.

The Somervell County Commissioners Court is responsible for the installation of the structural measures located in Somervell County with the exception of multiple-purpose structure No. 26. These are floodwater retarding structures Nos. 23 and 25.

The commissioners courts will take the following actions pertaining to the structural measures for which they are responsible:

1. Obtain all land rights needed legally for construction, operation, and maintenance and take related land rights action conforming to Service policy requirements.

2. Be responsible for working with the Service during construction of works of improvement. They will designate in writing an individual to serve as liaison between the court and the Service.

3. Determine the legal adequacy of land rights and use its power of eminent domain to obtain all land rights not donated.

4. Provide for the moving or modification of the utility lines, roads, and privately owned improvements necessary for installation of structural measures.

4-30004 10-72

The city of Glen Rose will be responsible for the installation of multiple-purpose structure No. 26. The city will take the following actions pertaining to the structure:

1. Obtain all land rights needed legally for construction, operation, and maintenance, and take related land rights action conforming to Service policy requirements.

2. Be responsible for working with the Service during construction of works of improvement. They will designate in writing an individual to serve as liaison between the city and the Service during the construction of works of improvement.

3. Determine the legal adequacy of land rights and use its power of eminent domain to obtain all land rights not donated.

4. Provide for the moving or modification of utility lines and systems, roads, and privately owned improvements as necessary for installation of structural measures.

5. Arrange with the Soil Conservation Service for the negotiation of an architectural and engineering contract with a private engineering firm to prepare construction plans and specifications relative to municipal water supply at multiple-purpose structure No. 26.

6. Provide at its own expense for professional engineers or other technical specialists to inspect or review the inspection of those features of construction work related to water supply at multiple-purpose structure No. 26 to the extent it elects to do so.

Technical assistance will be provided by the Soil Conservation Service in review of plans and specifications for multiple-purpose structure No. 26 and in preparation of plans and specifications for all other structural measures, inspection of construction, preparation of contract payment estimates, final inspection, execution of certification of completion, and related tasks necessary to install the planned structural measures. The appropriate sponsoring local organization will make whatever inspections it desires at its own expense.

The Soil Conservation Service, in compliance with the request made by the sponsors, will provide the necessary administrative and clerical personnel, facilities, and supplies to advertise, award and administer contracts and will be the contracting agency. The Service will also negotiate an A&E contract with a private engineering firm for the preparation of the plans and specifications for multiple-purpose structure No. 26.

The structural measures will be installed pursuant to the following conditions:

1. The requirements for land treatment in the drainage area above the floodwater retarding structures have been met.

2. All land rights have been obtained for all structural measures, or the sponsors have furnished a written statement to the effect that they have the means of securing land rights and the exact date by which all land rights will have been obtained. Following is a schedule, by 6-month periods, for obtaining needed land rights:

1st 6-month period	Floodwater retarding structures Nos. 1, 4, 6, 9, 10, 11, and 12, and multiple-purpose structure No. 17
2nd 6-month period	Floodwater retarding structures Nos. 19, 20, and 21, and multiple-purpose structure No. 16
3rd 6-month period	Floodwater retarding structures Nos. 8, 23, and 24
4th 6-month period	Floodwater retarding structures Nos. 5, 13, 14, and 25
5th 6-month period	Floodwater retarding structure No. 2 and multiple-purpose structure No. 26
6th 6-month period	Floodwater retarding structures Nos. 18 and 22
7th 6-month period	Floodwater retarding structures Nos. 3, 7, and 15

3. Water rights have been obtained for storage of water for irrigation in multiple-purpose structures Nos. 16 and 17, and storage of water for municipal uses in multiple-purpose structure No. 26.

4. Court orders have been obtained from the commissioners courts stating that low-water crossings affected by release flows from floodwater retarding structures will be improved on public road crossings to make them passable during periods of prolonged flow or that permission is granted to inundate such roads and equal alternate routes have been designated for use during periods of inundation.

5. Utilities such as power lines and telephone lines have been moved or permission has been granted to inundate the properties involved.

6. Reimbursable agreements between the Service and Hood County have been executed relative to the share of construction and engineering services costs of multiple-purpose structure No. 16 to be borne by local interests.

7. Reimbursable agreements between the Service and Erath County have been executed relative to the share of construction and engineering services costs of multiple-purpose structure No. 17 to be borne by local interests.

8. Reimbursable agreements between the Service and the city of Glen Rose have been executed relative to the share of construction and engineering services costs of multiple-purpose structure No. 26 to be borne by local interests.

9. Project and other financial agreements have been executed.

10. Operation and maintenance agreements have been executed.

11. Public Law 566 funds are available.

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out the works of improvement described in this work plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666), as amended.

The cost of installing the needed land treatment measures during the 8-year installation period will be borne by the landowners and operators of the land on which these measures are installed.

The Agricultural Stabilization and Conservation Service will provide financial assistance for the installation of those land treatment measures which are eligible for this assistance. The Farmers Home Administration, local banks, and other lending institutions can arrange financing for the landowners and operators' share of the cost.

The Soil Conservation Service will provide funds in the estimated amount of $263,478 to finance the cost of technical assistance in planning and application of the land treatment measures. This consists of $104,645 of Public Law 566 funds and $158,833 to be provided from Public Law 46 funds (table 1).

Funds for the local share of the cost of installing structures Nos. 1 through 25 will be provided by the commissioners court of the county in which the structural measure is located except for installation costs for multiple-purpose structures Nos. 16 and 17 allocated to irrigation water supply. These costs will be borne by the landowner involved. The landowner will pay the estimated amount of the construction and engineering service costs to the respective county commissioners court prior to the issuance of any invitation to bid. The structural measures for which each commissioners court is responsible are itemized under "Project Installation."

It is anticipated that 95 percent of the easements to be acquired will be donated. Out-of-pocket costs for land rights and project administration are expected to be $31,000.

Funds for the counties' share of the cost of installing the structural measures will be provided from the general funds of the counties and are supported by revenue from existing tax sources. These funds are adequate for financing the share of project installation cost to be borne by the counties.

The city of Glen Rose plans on obtaining a loan from the Farmers Home Administration to pay its share of the installation costs for multiple-purpose structure No. 26. Negotiations, including the filing of a letter of intent, are under way with the state director of the Farmers Home Administration. Public Law 566 credit assistance in the estimated amount of $102,670 will be required to finance the local share of project installation. Loan funds will be used to pay allocated construction and engineering costs, land rights, water rights, and project administration costs. The city anticipates that loan funds will be used to acquire about 140 acres of land. It is planned to obtain perpetual easements on the remainder of the land required for the installation of the multiple-purpose structure. The city is in sound financial condition and interest is high in developing a dependable water supply for the city. The city council believes a bond issue in support of a Farmers Home Administration loan will be met with approval.

Financial and other assistance to be furnished by the Soil Conservation Service is contingent on the appropriation of funds for this purpose. In addition, all prerequisite conditions will be met before federal funds will be made available for the installation of the structural measures.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by the landowners and operators of farms and ranches on which the measures are installed under agreements with the Bosque and the Hood-Parker Soil and Water Conservation Districts. Representatives of the districts will make periodic inspections of the completed land treatment measures to determine maintenance needs.

The structural measures will be operated and maintained by the commissioners courts in which the structure is located, except for the diversion works of structure No. 26, which will be operated and maintained by the city of Glen Rose. The accomplishment and financing will be the responsibility of the county in which the structural measure is located with the exception of structure No. 26. Funds for this purpose will come from the general fund of the county in which the structure is located. The general fund of each county is supported by existing taxes and is available and adequate for this purpose.

Erath County Commissioners Court will be responsible for structures Nos. 1 through 15 and 17 through 21.

Hood County Commissioners Court will be responsible for structures Nos. 16, 22, and 24.

Somervell County Commissioners Court will be responsbile for structures Nos. 23, 25, and 26.

The estimated average annual cost of operation and maintenance is based on adjusted normalized prices. This consists of $2,628, $460, and $512, respectively, for the structures located in Erath, Hood, and Somervell Counties. The Service and the sponsors will make a joint inspection annually or after unusually severe floods, or in the event of other unusual conditions that may adversely affect the works of improvement, for three years following installation of each structure. Inspection after the third year will be made annually by the sponsors. The Service will participate in annual inspections as often as it elects to do so after the third year. Inspection items are those items which may need maintenance. Items of inspection and maintenance for floodwater retarding and multiple-purpose structures will include, but will not be limited to, condition of principal spillways, earth fills, emergency spillways, vegetative cover, including wildlife plantings, fences, gates, and vegetative growth in reservoirs.

The appropriate counties will be responsible for and promptly perform, or have performed, without cost to the Service, all maintenance of the structural measures as determined to be needed by either the sponsors or the Service immediately following completion of the structures by the contractor. The counties will be responsible for maintenance of vegetation associated with structural measures after the initial vegetation work is adequately completed, as determined by the Service, but not later than three years following completion of each structural measure.

The Soil Conservation Service, through the soil and water conservation districts, will participate in operation and maintenance only to the extent of furnishing technical assistance to aid in inspections and technical guidance and information necessary for the operation and maintenance program.

Provisions will be made for free access of representatives of the sponsoring local organizations and of authorized representatives to inspect and provide for maintenance of all structural measures and their appurtenances at any time.

The counties will prepare a report of all maintenance inspections. A copy of this report will be submitted to the Service representative. The counties will keep summary control records in support of proper maintenance having been performed on these works of improvement.

An operation and maintenance agreement will be executed by the parties hereto prior to the signing of the initial project agreement and the issuance of invitations to bid on construction of the structural measures. The agreement will set forth specific details on procedure in line with recognized assignments of responsibility.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Paluxy River Watershed, Texas

Installation Cost Item	Unit	Number To Be Applied	Estimated Cost (Dollars)1/ Public Law 566 Funds	Other	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	9,380	-	452,116	452,116
Grassland	Acre	45,899	-	1,805,822	1,805,822
Technical Assistance			104,645	158,833	263,478
SCS Subtotal			104,645	2,416,771	2,521,416
TOTAL LAND TREATMENT			104,645	2,416,771	2,521,416
STRUCTURAL MEASURES					
Construction					
Soil Conservation Service					
Floodwater Retarding Structures	No.	23	2,691,762	-	2,691,762
Multiple-Purpose Structures	No.	3	637,432	77,899	715,331
Diversion Works	No.	1	-	3,000	3,000
SCS Subtotal			3,329,194	80,899	3,410,093
Subtotal - Construction			3,329,194	80,899	3,410,093
Engineering Services					
Soil Conservation Service					
Floodwater Retarding Structures	No.	23	158,252	-	158,252
Multiple-Purpose Structures	No.	3	32,920	3,973	36,893
Diversion Works	No.	1	-	354	354
Subtotal - Engineering			191,170	4,327	195,499
Project Administration					
Soil Conservation Service					
Construction Inspection			253,615	500	254,115
Other			295,695	13,000	308,695
Subtotal - Administration			549,310	13,500	562,810
Other Costs					
Land Rights			-	408,951	408,951
Water Rights			-	2,000	2,000
Subtotal - Other			-	410,951	410,951
TOTAL STRUCTURAL MEASURES			4,069,676	509,677	4,579,353
TOTAL PROJECT			4,174,321	2,926,448	7,100,769
SUMMARY					
Subtotal SCS			4,174,321	2,926,448	7,100,769
TOTAL PROJECT			4,174,321	2,926,448	7,100,769

1/ Price Base: 1971

January 1972

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Paluxy River Watershed, Texas

Measure	Unit	Applied to Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Conservation Cropping System	Acre	13,426	134,260
Diversion	Foot	197,604	23,712
Terrace	Foot	1,488,579	148,856
Pasture and Hayland Planting	Acre	9,812	294,360
Pasture and Hayland Management	Acre	7,367	73,670
Brush Control	Acre	86,833	1,302,495
Proper Grazing Use	Acre	121,228	242,456
Range Seeding	Acre	9,385	140,775
Pond	No.	574	344,400
Upland Wildlife Habitat Management	Acre	1,726	1,726
Fishpond Management	No.	129	1,032
TOTAL LAND TREATMENT			2,707,742

1/ Price Base: 1971

January 1972

4-30004

4-30004

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Paluxy River Watershed, Texas
(Dollars)1/

Item	Installation Cost - PL 566 Funds			Installation Cost - Other Funds					Total Installation Cost
	Construction	Engineering	Total PL 566	Construction	Engineering	Land Rights	Water Rights	Total Other	
Floodwater Retarding Structures:									
1	69,176	4,842	74,018	-	-	6,785	-	6,785	80,803
2	89,507	6,265	95,772	-	-	6,672	-	6,672	102,444
3	66,320	4,642	70,962	-	-	4,456	-	4,456	75,418
4	79,720	5,580	85,300	-	-	3,558	-	3,558	88,858
5	103,359	6,202	109,561	-	-	7,695	-	7,695	117,256
6	100,166	6,010	106,176	-	-	9,207	-	9,207	115,383
7	207,574	10,379	217,953	-	-	33,020	-	33,020	250,973
8	55,275	4,422	59,697	-	-	7,000	-	7,000	66,697
9	73,620	5,153	78,773	-	-	5,945	-	5,945	84,718
10	58,430	4,090	62,520	-	-	4,857	-	4,857	67,377
11	46,940	3,755	50,695	-	-	4,220	-	4,220	54,915
12	78,442	5,491	83,933	-	-	9,920	-	9,920	93,853
13	159,915	7,996	167,911	-	-	21,945	-	21,945	189,856
14	79,164	5,541	84,705	-	-	9,507	-	9,507	94,212
15	130,033	7,802	137,835	-	-	21,007	-	21,007	158,842
18	259,284	12,964	272,248	-	-	38,002	-	38,002	310,250
19	145,900	8,754	154,654	-	-	18,300	-	18,300	172,954
20	175,814	8,791	184,605	-	-	17,974	-	17,974	202,579
21	181,300	9,065	190,365	-	-	22,200	-	22,200	212,565
22	180,627	9,031	189,658	-	-	39,750	-	39,750	229,408
23	99,570	6,970	106,540	-	-	7,512	-	7,512	114,052
24	96,297	6,741	103,038	-	-	12,275	-	12,275	115,313
25	155,329	7,766	163,095	-	-	17,457	-	17,457	180,552
Subtotal	2,691,762	158,252	2,850,014	-	-	329,264	-	329,264	3,179,278
Multiple-Purpose Structures:									
16	104,883	6,293	111,176	7,677	461	10,410	500	19,048	130,224
17	205,268	10,263	215,531	13,731	687	30,277	500	45,195	260,726
26	327,281	16,364	343,645	56,491	2,825	39,000	1,000	99,316	442,961
Diversion Works (Structure 26)	-	-	-	3,000	354	-	-	3,354	3,354
Subtotal	637,432	32,920	670,352	80,899	4,327	79,687	2,000	166,913	837,265
Subtotal - Watershed	3,329,194	191,172	3,520,366	80,899	4,327	408,951	2,000	496,177	4,016,543
Project Administration	xxx	xxx	549,310	xxx	xxx	xxx	xxx	13,500	562,810
GRAND TOTAL	3,329,194	191,172	4,069,676	80,899	4,327	2/408,951	2,000	509,677	4,579,353

1/ Price Base: 1971
2/ Includes $3,550 for legal fees, and $9,150 for modification of fixed improvements

January 1972

4-30004

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Paluxy River Watershed, Texas
(Dollars) 1/

Item	COST ALLOCATION PURPOSE				COST SHARING PL 566				COST SHARING OTHER			
	Flood Prevention	Irrigation	Municipal Water	Total	Flood Prevention	Irrigation	Municipal Water	Total	Flood Prevention	Irrigation	Municipal Water	Total
Single Purpose												
Floodwater Retarding Structures	3,179,278	-	-	3,179,278	2,850,014	-	-	2,850,014	329,264	-	-	329,264
Diversion Works	-	-	3,354	3,354	-	-	-	-	-	-	3,354	3,354
Subtotal	3,179,278	-	3,354	3,182,632	2,850,014	-	-	2,850,014	329,264	-	3,354	332,618
Multiple-Purpose												
Structure No. 16	120,876	9,348	-	130,224	111,176	-	-	111,176	9,700	9,348	-	19,048
Structure No. 17	243,910	16,816	-	260,726	215,531	-	-	215,531	28,379	16,816	-	45,195
Structure No. 26	376,904	-	66,057	442,961	343,645	-	-	343,645	33,259	-	66,057	99,316
Subtotal	741,690	26,164	66,057	833,911	670,352	-	-	670,352	71,338	26,164	66,057	163,559
GRAND TOTAL	3,920,968	26,164	69,411	4,016,543	3,520,366	-	-	3,520,366	400,602	26,164	69,411	496,177

1/ Price Base: 1971

January 1972

TABLE 3 - STRUCTURAL DATA - STRUCTURES WITH PLANNED STORAGE CAPACITY
Paluxy River Watershed, Texas

Item	Unit	Structure Number 1	2	3	4	5	6	7	8	9
Class of Structure		a	a	a	a	a	a	b	a	a
Drainage Area	Sq. Mi.	3.90	3.06	2.40	2.11	4.34	4.84	11.94	2.02	3.04
Controlled	Sq. Mi.	-	-	-	-	-	-	-	-	-
Curve No. (1-Day)(AMC II)		74	75	75	75	75	75	75	75	75
TC	Hrs.	1.44	1.74	1.50	1.50	2.40	1.94	3.70	1.07	1.57
Elevation Top of Dam	Ft.	1239.3	1229.3	1233.1	1194.5	1182.0	1192.8	1073.7	1101.2	1168.9
Elevation Crest Emergency Spillway	Ft.	1234.0	1224.0	1227.5	1189.0	1177.0	1187.0	1066.3	1098.0	1163.0
Elevation Crest Principal Spillway	Ft.	1215.5	1205.8	1212.2	1173.2	1158.1	1167.8	1047.2	1082.3	1147.7
Elevation Crest Lowest Ungated Outlet	Ft.	1215.5	1205.8	1212.2	1173.2	1158.1	1167.8	1044.8	1082.3	1147.7
Maximum Height of Dam	Ft.	51	46	50	42	60	54	50	40	45
Volume of Fill	Cu.Yds.	120,300	169,700	107,600	120,400	182,800	196,000	462,100	104,000	105,900
Total Capacity	Ac. Ft.	1,040	806	545	473	1,128	1,211	3,566	711	709
Sediment Pool (Lowest Ungated Outlet)	Ac. Ft.	137	102	93	74	153	150	200	71	146
Sediment Submerged 100 Years	Ac. Ft.	137	102	93	74	153	150	376	71	146
Sediment Aerated	Ac. Ft.	23	18	17	13	18	23	51	9	18
Irrigation Water Supply	Ac. Ft.	-	-	-	-	-	-	-	-	-
Municipal Water Supply Pool	Ac. Ft.	-	-	-	-	-	-	-	-	-
Retarding Pool	Ac. Ft.	880	686	435	386	957	1,038	3,139	631	545
Surface Area										
Sediment Pool (Lowest Ungated Outlet)	Acres	24	20	16	15	25	24	58	13	20
Sediment Pool (Principal Spwy. Crest)	Acres	24	20	16	15	25	24	81	13	20
Irrigation Water Supply	Acres	-	-	-	-	-	-	-	-	-
Municipal Water Supply	Acres	-	-	-	-	-	-	-	-	-
Retarding Pool	Acres	79	60	45	35	83	88	258	74	54
Principal Spillway										
Rainfall Volume (Areal)(1-Day)	In.	8.45	8.10	6.40	7.50	8.20	7.80	8.22	10.70	7.40
Rainfall Volume (Areal)(10-Day)	In.	13.60	13.50	12.10	12.20	13.30	12.70	13.55	17.20	12.00
Runoff Volume (10-Day)	In.	6.81	6.93	6.00	6.15	6.66	6.17	6.28	10.35	5.76
Capacity (Maximum)	C.F.S.	75	75	76	72	81	75	192	73	72
Frequency Operation - Emer. Spillway	% Chance	1.9	2.0	3.9	3.8	2.2	2.9	2.0	0.4	4.0
Size of Conduit	In.	24	24	24	24	24	24	36	24	24
Emergency Spillway										
Rainfall Volume (ESH)(Areal)	In.	6.70	6.70	6.70	6.70	6.70	6.70	9.31	6.70	6.70
Runoff Volume (ESH)	In.	3.78	3.88	3.88	3.88	3.88	3.88	6.23	3.88	3.88
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Bottom Width	Ft.	120	100	80	80	160	130	350	100	100
Velocity of Flow (V_e)	Ft./Sec.	0	0	0	0	0	0	5.6	0	0
Slope of Exit Channel	Ft./Ft.	0.140	0.071	0.071	0.093	0.059	0.140	0.024	0.027	0.082
Maximum Water Surface Elev.	Ft.	-	-	-	-	-	-	1068.1	-	-
Freeboard										
Rainfall Volume (FH)(Areal)	In.	13.80	13.80	13.80	13.80	13.80	13.80	20.59	13.80	13.80
Runoff Volume (FH)	In.	10.33	10.47	10.47	10.47	10.47	10.47	17.07	10.47	10.47
Maximum Water Surface Elevation	Ft.	1039.3	1029.3	1233.1	1194.5	1182.0	1192.8	1073.7	1101.2	1168.9
Capacity Equivalents										
Sediment Volume	In.	.77	.74	.86	.77	.74	.67	.67	.74	1.01
Water Supply	In.	-	-	-	-	-	-	-	-	-
Retarding Volume	In.	4.23	4.20	3.40	3.43	4.13	4.02	4.93	5.86	3.36

TABLE 3 - STRUCTURAL DATA - STRUCTURES WITH PLANNED STORAGE CAPACITY - continued
Paluxy River Watershed, Texas

Item	Unit	Structure Number 10	11	12	13	14	15	16	17	18
Class of Structure		a	a	a	a	a	a	a	a	b
Drainage Area	Sq. Mi.	2.01	1.39	4.51	12.00	3.91	12.31	4.87	20.61	23.61
Controlled	Sq. Mi.	-	-	-	-	-	-	-	-	20.61
Curve No. (1-Day)(AMC II)		75	75	76	75	75	75	75	75	75
TC	Hrs.	1.17	.84	2.00	3.06	1.57	3.90	1.65	3.85	5.48
Elevation Top of Dam	Ft.	1091.7	1017.1	1111.8	998.6	996.5	925.0	873.3	1069.4	904.7
Elevation Crest Emergency Spillway	Ft.	1086.5	1012.5	1106.0	992.0	991.0	918.0	867.0	1059.0	893.5
Elevation Crest Principal Spillway	Ft.	1073.7	997.9	1088.1	974.1	975.4	897.2	850.0	1035.2	871.3
Elevation Crest Lowest Ungated Outlet	Ft.	1073.7	997.9	1088.1	971.8	975.4	896.9	850.0	1035.2	864.7
Maximum Height of Dam	Ft.	39	40	46	54	42	53	50	74	66
Volume of Fill	Cu. Yds.	73,900	63,300	136,700	277,100	134,800	227,300	221,400	444,000	533,500
Total Capacity	Ac. Ft.	438	294	1,155	2,798	967	2,468	1,408	5,200	6,011
Sediment Pool (Lowest Ungated Outlet)	Ac. Ft.	65	42	111	200	113	200	-	-	200
Sediment Submerged 100 Years	Ac. Ft.	65	42	111	307	113	217	200	681	736
Sediment Aerated	Ac. Ft.	8	3	12	26	8	19	23	77	61
Irrigation Water Supply	Ac. Ft.	-	-	-	-	-	-	96	326	-
Municipal Water Supply	Ac. Ft.	-	-	-	-	-	-	-	-	-
Retarding Pool	Ac. Ft.	365	249	1,032	2,465	846	2,232	1,089	4,116	5,214
Surface Area										
Sediment Pool (Lowest Ungated Outlet)	Acres	14	8	25	36	20	42	-	-	53
Sediment Pool (Principal Spwy. Crest)	Acres	14	8	25	54	20	43	-	-	112
Irrigation Water Supply	Acres	-	-	-	-	-	-	39	103	-
Municipal Water Supply	Acres	-	-	-	-	-	-	-	-	-
Retarding Pool	Acres	45	29	100	235	99	186	93	267	378
Principal Spillway										
Rainfall Volume (Areal)(1-Day)	In.	7.40	7.60	7.95	8.20	8.00	7.60	7.90	7.80	8.50
Rainfall Volume (Areal)(10-Day)	In.	12.00	12.40	12.90	13.20	13.00	12.40	12.80	13.00	14.00
Runoff Volume (10-Day)	In.	6.01	6.46	6.64	6.03	6.46	5.47	6.24	5.68	6.32
Capacity (Maximum)	C.F.S.	69	70	73	202	73	200	73	218	545
Frequency Operation - Emer. Spillway	% Chance	4.0	3.4	2.6	2.3	2.5	3.4	2.7	2.4	1.4
Size of Conduit	In.	24	24	24	36	24	36	24	36	1/ 48x48
Emergency Spillway										
Rainfall Volume (ESH)(Areal)	In.	6.70	6.70	6.70	6.63	6.70	6.60	6.70	6.45	8.31
Runoff Volume (ESH)	In.	3.88	3.88	3.99	3.82	3.88	3.79	3.88	3.67	5.32
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Bottom Width	Ft.	70	80	100	200	100	200	100	300	400
Velocity of Flow (V_e)	Ft./Sec.	0	0	0	0	0	2.4	0	0	8.2
Slope of Exit Channel	Ft./Ft.	0.059	0.079	0.095	0.049	0.079	0.039	0.114	0.060	0.050
Maximum Water Surface Elevation	Ft.	-	-	-	-	-	918.5	-	-	896.0
Freeboard										
Rainfall Volume (FH)(Areal)	In.	13.80	13.80	13.80	13.66	13.80	13.59	13.80	18.20	18.20
Runoff Volume (FH)	In.	10.47	10.47	10.62	10.34	10.47	10.27	10.47	14.73	14.73
Maximum Water Surface Elevation	Ft.	1091.7	1017.1	1111.8	998.6	996.5	925.0	873.3	1069.4	904.7
Capacity Equivalents										
Sediment Volume	In.	.68	.61	.51	.52	.58	.36	.86	.69	.65
Water Supply Volume	In.	-	-	-	-	-	-	.37	.30	-
Retarding Volume	In.	3.40	3.36	4.29	3.85	4.06	3.40	4.19	3.74	4.25

1/ Dimensions of a square or rectangular conduit.

TABLE 3 - STRUCTURAL DATA - STRUCTURES WITH PLANNED STORAGE CAPACITY - continued
Paluxy River Watershed, Texas

Item	Unit	Structure Number 19	20	21	22	23	24	25	26	Total
Class of Structure		a	a	a	a	a	a	a	c	
Drainage Area	Sq. Mi.	11.36	17.89	15.62	16.36	4.64	6.29	11.44	13.32	219.18
Controlled	Sq. Mi.	-	-	-	33.51	-	-	-	-	
Curve No. (1-Day)(AMC II)		77	76	79	75	77	75	76	77	
TC	Hrs.	3.10	3.23	2.86	4.37	2.20	1.92	2.72	2.73	
Elevation Top of Dam	Ft.	1049.8	985.7	1036.2	806.7	970.0	856.7	845.7	778.4	
Elevation Crest Emergency Spillway	Ft.	1042.5	977.0	1028.0	800.5	964.5	850.5	838.5	765.8	
Elevation Crest Principal Spillway	Ft.	1016.5	947.5	997.0	783.5	939.2	831.7	813.0	741.5	
Elevation Crest Lowest Ungated Outlet	Ft.	1015.4	940.8	990.2	779.8	939.2	830.4	809.6	741.5	
Maximum Height of Dam	Ft.	62	72	72	56	57	54	61	80	
Volume of Fill	Cu. Yds.	298,100	376,400	395,850	270,900	197,200	185,600	342,100	609,900	6,356,850
Total Capacity	Ac. Ft.	2,811	4,446	4,324	4,136	1,292	1,617	3,148	4,756	57,458
Sediment Pool (Lowest Ungated Outlet)	Ac. Ft.	200	200	200	200	181	200	200	-	3,438
Sediment Submerged 100 Years	Ac. Ft.	236	534	517	506	181	245	342	341	6,676
Sediment Aerated	Ac. Ft.	31	48	41	44	15	27	30	21	684
Irrigation Water Supply	Ac. Ft.	-	-	-	-	-	-	-	-	422
Municipal Water Supply	Ac. Ft.	-	-	-	-	-	-	-	700	700
Retarding Pool	Ac. Ft.	2,544	3,864	3,766	3,586	1,096	1,345	2,776	3,694	48,976
Surface Area										
Sediment Pool (Lowest Ungated Outlet)	Acres	34	36	35	70	22	31	36	-	677
Sediment Pool (Principal Spwy. Crest)	Acres	38	65	56	105	22	35	49	-	884
Irrigation Water Supply	Acres	-	-	-	-	-	-	-	-	142
Municipal Water Supply	Acres	-	-	-	-	-	-	-	85	85
Retarding Pool	Acres	172	220	209	331	71	125	181	229	3,746
Principal Spillway										
Rainfall Volume (Areal)(1-Day)	In.	7.90	8.00	8.20	8.08	8.15	7.60	8.40	9.38	
Rainfall Volume (Areal)(10-Day)	In.	12.80	13.20	13.50	13.46	13.20	12.50	13.70	15.25	
Runoff Volume (10-Day)	In.	6.19	6.16	6.97	6.10	7.02	5.86	6.71	7.92	
Capacity (Maximum)	C.F.S.	133	215	214	610	79	74	131	215	
Frequency Operation - Emer. Spillway	% Chance	2.8	2.3	1.9	2.0	2.4	3.2	1.9	1.0	
Size of Conduit	In.	30	36	36	1/ 48x54	24	24	30	36	
Emergency Spillway										
Rainfall Volume (ESH)(Areal)	In.	6.63	6.53	6.60	9.22	6.70	6.70	6.63	12.84	
Runoff Volume (ESH)	In.	4.03	3.84	4.22	6.15	4.09	3.88	3.93	9.85	
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	
Bottom Width	Ft.	200	250	250	500	160	150	200	400	
Velocity of Flow (V_e)	Ft./Sec.	0	0	0	6.8	0	0	0	10.0	
Slope of Exit Channel	Ft./Ft.	0.114	0.074	0.127	0.040	0.139	0.058	0.056	0.023	
Maximum Water Surface Elev.	Ft.	-	-	-	802.6	-	-	-	770.8	
Freeboard										
Rainfall Volume (FH)(Areal)	In.	13.76	14.19	14.19	14.19	13.80	13.80	13.67	30.08	
Runoff Volume (FH)	In.	10.73	11.00	11.43	10.85	10.77	10.47	10.49	26.77	
Maximum Water Surface Elevation	Ft.	1049.8	985.7	1036.2	806.7	970.0	856.7	845.7	778.4	
Capacity Equivalents										
Sediment Volume	In.	.44	.61	.67	.63	.79	.81	.61	.51	
Water Supply Volume	In.	-	-	-	-	-	-	-	.98	
Retarding Volume	In.	4.20	4.05	4.52	4.11	4.43	4.01	4.55	5.20	

1/ Dimensions of a square or rectangular conduit.

TABLE 4 - ANNUAL COST

Paluxy River Watershed, Texas

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost	Operation and Maintenance Cost	Total
23 Floodwater Retarding Structures and 3 Multiple-Purpose Structures	221,954	3,600	225,554
Project Administration	31,101	xxx	31,101
GRAND TOTAL	253,055	3,600	256,655

1/ Price Base: Installation, 1971 prices amortized for 100 years at 5.500 percent interest; operation and maintenance at 1970 prices.

January 1972

4-30004 10-72

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
Paluxy River Watershed, Texas
(Dollars) 1/

Item	Estimated Average Annual Damage: Without Project	With Project	Damage Reduction Benefit
Floodwater			
Crop and Pasture	68,606	19,548	49,058
Other Agricultural	31,882	9,609	22,273
Non-Agricultural			
Road and Bridge	49,520	12,190	37,330
Dinosaur Valley State Park	22,720	1,770	20,950
Glen Rose Urban	138,440	5,610	132,830
Subtotal	311,168	48,727	262,441
Sediment			
Overbank Deposition	5,802	3,000	2,802
Lake Whitney	5,431	2,273	3,158
Subtotal	11,233	5,273	5,960
Erosion			
Flood Plain Scour	10,799	4,137	6,662
Streambank Erosion	9,273	3,377	5,896
Subtotal	20,072	7,514	12,558
Indirect	55,320	8,108	47,212
TOTAL	2/ 397,793	2/ 69,622	2/ 328,171

1/ Price Base: Adjusted normalized prices (April 1966) for agricultural damages and 1970 prices for non-agricultural damages
2/ Includes damages and benefits for entire benefited area

January 1972

4-30004 10-72

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES
Paluxy River Watershed, Texas
(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS1/							Average Annual Cost 2/	Benefit-Cost Ratio
	Damage Reduction	More Intensive Land Use	Incidental Recreation	Irrigation	Municipal Water Supply	Secondary	Total		
23 Floodwater Retarding Structures and 3 Multiple-Purpose Structures	317,950	13,570	7,100	6,041	11,190	71,700	427,551	225,554	1.9:1.0
Project Administration	xxx	xxx	xxx	xxx	xxx	xxx	xxx	31,101	xxx
GRAND TOTAL 3/	317,950	13,570	7,100	6,041	11,190	71,700	427,551	256,655	1.7:1.0

1/ Price Base: Adjusted normalized prices (April 1966) for agricultural benefits and 1970 prices for non-agricultural benefits
2/ From table 4
3/ In addition, it is estimated that land treatment measures will provide $10,221 damage reduction benefits in the benefited area

January 1972

INVESTIGATIONS AND ANALYSES

Land Use and Treatment

The status of land treatment measures for the watershed was developed by supervisors of the Bosque and the Hood-Parker Soil and Water Conservation Districts, with assistance from Soil Conservation Service personnel headquartered at Stephenville, Granbury, and Glen Rose, Texas. Representative basic soil and water conservation plans were analyzed both in the office and on the land. The findings were expanded for the entire watershed.

This analysis provided pertinent data on total conservation needs, accomplishments to date, and remaining needs, and was used in the establishment of priorities for planning, application, and maintenance of needed land treatment measures.

The funds needed for accelerated technical assistance represent the difference in the amount of funds now being expended and those which will be required to meet the project goal of the application of 80 percent of all needed land treatment by the end of the 8-year installation period.

Engineering Investigations

The procedures used to determine the most feasible plan of structural measures to meet the objectives of the sponsoring local organizations that could not be accomplished by land treatment measures were as follows:

1. A base map of the watershed, showing watershed boundary, drainage pattern, systems of roads, utility lines, and other pertinent information, was prepared.

2. Possible sites for structural measures that would accomplish project objectives were located by use of topographic maps and aerial photographs, supplemented with field investigations. Preliminary stage-capacity and stage-area information at the possible sites was developed from U.S. Geological Survey topographic maps. This information was used to determine the landowners and improvements that would be involved and the physical feasibility of the site and to provide data for laying out field surveys.

3. Surveys - Engineering surveys were made after preliminary agreement was reached with the sponsoring local organizations on the sites to be studied for potential structural measures. Property lines and ownership of the land involved were furnished by the sponsors.

    a. Vertical control - Existing U.S. Geological Survey and U.S. Coast and Geodetic Survey bench marks were supplemented with temporary bench marks set at strategic locations for use in making surveys.

    b. Sites - Field surveys were made in two stages. First, topographic maps of 27 sites were prepared. Roads, utility lines, and miscellaneous improvements located within the reservoir areas

were surveyed. Second, after preliminary designs and layouts of the floodwater retarding structures that would be feasible to install were reviewed and accepted by the sponsors, detailed topographic surveys of the emergency spillway areas were made. A profile survey of the centerline of each dam site was made. These surveys provided the data necessary to determine the most economical design, to make estimates of the installation cost, and to prepare the land rights work maps.

4. Designs - Design of structural measures was a continuous process during work plan development. Designs were made of individual or related groups of structures as information was collected and surveys were completed.

Structures were classified for limiting design criteria by considering the damages that might occur to existing developments downstream from an instantaneous breach of any one dam. All structures, with the exception of Nos. 7, 18, and 26, are class "a" structures because damages would be limited to agricultural lands, county roads, and farm-to-market roads in the event of a structural failure.

Structure No. 7 was given a "b" classification due to the proximity of U.S. Highway 281, which is located one-half mile below the dam.

Structure No. 18 was given a "b" classification because a breach study indicated that an isolated farmstead located one-half mile downstream would be flooded in the event of a failure.

Breach studies indicated that no undue flooding would occur in Glen Rose in the event of failure of any one of the class "a" or "b" structures.

Classification of "c" was given to structure No. 26 because of its proximity to the city of Glen Rose.

Pertinent data regarding structure classification for each site is shown on the following tabulation:

Floodwater Retarding Structure No.	Drainage Area (acres)	Peak Discharge from an Instantaneous Breach (c.f.s.)	Flood Plain Distance Above Glen Rose (miles)	Class of Structure
1	2,496	33,844	46.2	a
2	1,958	35,200	45.7	a
3	1,536	45,340	46.1	a
4	1,350	34,600	43.0	a
5	2,778	45,410	41.2	a
6	3,098	48,939	42.0	a
7	7,642	50,400	35.8	b
8	1,293	24,274	36.3	a
9	1,946	35,400	35.0	a
10	1,286	22,420	33.3	a
11	890	42,560	30.3	a
12	2,886	35,800	33.1	a
13	7,680	39,618	29.1	a
14	2,502	24,836	29.3	a
15	7,878	43,833	26.1	a
16	3,117	34,512	18.9	a
17	13,190	91,000	25.6	a
18	14,720	69,000	19.3	b
19	7,270	82,200	23.5	a
20	11,450	80,000	20.4	a
21	9,997	77,360	21.7	a
22	10,470	68,500	13.7	a
23	2,970	61,360	14.7	a
24	4,026	36,118	11.2	a
25	7,322	78,800	9.8	a
26	8,525	103,400	4.4	c

Hydraulic investigations indicate that flooding starts in the main part of town when the peak discharge reaches approximately 65,000 cubic feet per second. Flooding starts at valley cross section 201 at the minimum section when the discharge reaches about 48,000 cubic feet per second. Detailed breach studies were made of Site 26 and recommendations for site classification for the remainder of the sites were based on these studies. These studies indicated that the peak discharge of 103,400 cubic feet per second resulting from a breach would route down to 83,000 cubic feet per second by the time it reached the urban area.

Hydrologic criteria used in design of the structures equal or exceed that required in Engineering Memorandum-27 (Rev.) Floodwater retarding capacity requirements and the percent chance of use of emergency spillways were determined by procedures outlined in chapter 21, NEH 4, and Technical Release No. 33.

Emergency spillway and freeboard hydrographs were developed and flood routed to determine the elevation of emergency spillway, dimensions of emergency spillway, and elevation of top of dam for each structure.

Flood routings indicated that discharges through the emergency spillways would not contribute significantly to the peak discharges expected to occur along the Paluxy River in the vicinity of Glen Rose. Therefore, it was not necessary to add additional retarding storage to the structures in excess of that required for the safe design of the structures.

5. Cost estimates - Construction costs were based on unit prices being expended at similar sites, Soil Conservation Service experience, and values furnished by local organizations and utility companies.

   Evaluation of the estimated cost of installing different systems of structures was made to determine the least costly system to meet project objectives. Alternate cost estimates indicated that the 26 structures included in the plan were the most feasible means of controlling the floodwater from the uplands.

   Each dam was analyzed to determine the least costly combination of emergency spillways and embankments.

Hydraulic and Hydrologic Investigations

The following steps were taken as part of the hydraulic and hydrologic investigations:

1. Basic meteorologic and hydrologic data were obtained from the Weather Bureau, Environment Science Services Administration,

U. S. Department of Commerce. Seventy-one years of records are available for the Weather Bureau station at Dublin, Erath County, Texas. Rainfall frequency data for the watershed were obtained from U.S. Weather Bureau Technical Paper No. 40, "Rainfall Frequency Atlas for the United States." An adjustment for areal rainfall was applied in each of the evaluation reaches.

U. S. Geological Survey records for the stream gage on the Paluxy River were tabulated. Log-Pearson Type 3 method was used to determine flood flow frequencies at the gage.

2. The present hydrologic conditions were determined from a 10 percent sampling of soil and cover complex conditions. Areas showing significant variations in hydrologic soils groupings, as well as in land use and cover conditions, were delineated on a watershed base map. The with project hydrologic conditions were determined by considering the effect of changes in land use and treatment that are expected during the installation period.

   The weighted Average II Condition curve number for the watershed was computed to be 76.

3. The area subject to damage from flooding was determined by studies of aerial photos, U. S. Geological survey quadrangle sheets, and field interviews with local residents.

4. Engineering surveys were made of 107 valley cross sections, of which 21 sections were surveyed by the U.S. Corps of Engineers, to represent the stream hydraulics and flood plain area. Preliminary locations for sections were made on aerial photos, giving consideration to the needs of the geologist and economist. The final locataions were selected on the ground. Elevations of homes and businesses in Glen Rose that were expected to flood were determined during the survey of valley sections.

5. The computer was used to solve the water surface profiles and develop the stage-discharge relationship for the valley cross sections.

6. Flood routings were done by the computer, using the TR-20 program. The relationship of peak discharge to runoff was developed at each proposed structure site and at each valley cross section.

   The without project routed peak discharges at the Paluxy River gaging station, located 500 feet upstream from U. S. Highway 67, were in agreement with the flow frequency data developed from the gage records.

7. Stage-area inundated curves were developed by computer for each portion of the agricultural flood plain represented by a single

cross section. Area inundated depths of 0-1, 1-3, and 3 feet plus depth increments were determined for selected frequency storm events.

8. Determinations were made of the area that would be flooded by the selected frequency floods under each of the following conditions:

   a. Without project conditions in the watershed remaining static.

   b. With project conditions of the watershed. Various systems of retarding structures were evaluated to determine the most feasible system to reduce flooding. The system of structural measures selected will reduce damages to both agricultural land within the watershed and the city of Glen Rose to an acceptable level.

9. Reservoir operation studies were completed to determine the adequacy of additional storage provided in the proposed multiple-purpose structures. The planned storage for the municipal and industrial water was determined by a consultant engineer employed by the city of Glen Rose. From these studies it was determined that the additional storage, as planned, would meet the future demands.

Sedimentation Investigations

Sedimentation investigations were made as follows:

1. The 100-year sediment storage requirements for all floodwater retarding structures were made according to procedures outlined in Technical Release No. 12 (Rev.), "Sediment Storage Requirements for Reservoirs," USDA, SCS, January 1968. The following field and office studies were made:

   a. Erosion rates for the watershed were developed from a 10 percent sampling of the uplands. Sampled data on soil, slope, cover, and treatment conditions were tabulated and summarized within topographically similar soils areas. The Musgrave soil loss equation was used to arrive at estimated gross sheet erosion rates within each of these areas. Gully and streambank erosion rates were calaculated from data obtained in field and aerial photograph study.

   b. The estimated gross erosion expected to occur within the drainage area of each structure was adjusted for expected delivery and the trap efficiency of the reservoir. The sediment delivery ratio used was based on size of the drainage area and the trap efficiency was estimated to be 90 percent.

   c. Allowances for differences in density of aerated and submerged sediment are based on the following volume weights:

Texture	Aerated	Submerged
Fine	84	44
Medium	95	56
Coarse	98	77

d. The allocation of sediment in the structure pools is as follows:

Period of Deposition	Pool	Condition	Texture of Upland Soils		
			Fine	Medium	Coarse
1st 50 Yrs.	Sediment	Submerged	90	85	80
	Detention	Aerated	10	15	20
2nd 50 Yrs.	Sediment	Submerged	85	80	75
	Detention	Aerated	15	20	25

2. Sediment and scour damage investigations on the flood plain were made by the valley cross section survey method. Most of the overbank deposition damage occurs on a frequently flooded first bottom flood plain and was surveyed and tabulated as an annual damage. Most of the scour damage occurs on somewhat less frequently flooded, extensively cultivated second bottom flood plain and was investigated and evaluated on the basis of estimated potential scour damage from various size frequency storms. Depth of floodwater, depth and width of previously scoured areas, and the land use and cropping systems on the flood plain were the main factors used in estimating potential damage by each size storm.

3. Damage to Lake Whitney by sediment produced and delivered from the watershed was based on the gross erosion data used in estimating sediment storage requirements for the structures and estimated volume of sediment produced by streambank erosion and flood plain scour. This gross erosion volume was adjusted for expected delivery and estimated volume weights of the sediment deposited in various areas of the reservoir.

Geologic Investigations

Preliminary geologic dam site investigations were made and reports prepared for each of the structure sites. These investigations included studies of valley slopes, alluvium, and exposed geologic formations.

All of the planned structures are located on sedimentary rocks of Lower Cretaceous age. The foundations and abutments of Sites 1 through 15 are on

the poorly cemented sandstone and soft shale bedrock of the Twin Mountains Formation. The foundations and abutments of Sites 19, 20, 21, 23, 24, 25, and 26 are on soft calcareous shale and interbedded, moderately hard to hard limestone bedrock of the Glen Rose Formation. Sites 16, 17, 18, and 22 have foundations resting on the Twin Mountains Formation and abutments on the Glen Rose Formation.

Investigations at multiple-purpose Site 26 by the consulting engineer retained by the city of Glen Rose included the drilling of four exploratory holes to obtain foundation information and determine water-holding capability.

Detailed investigations, including exploration with core drilling equipment, will be made at each floodwater retarding structure site prior to construction to determine the suitability and methods of handling foundation and embankment materials.

Economic Investigations

Basic methods used in the economic investigations and analyses are outlined in the "Economics Guide for Watershed Protection and Flood Prevention," U.S. Department of Agriculture, Soil Conservation Service, March 1966. Twenty agricultural reaches and one urban reach were evaluated. It was felt that the use of 20 agricultural reaches would portray the effects of structural measures most accurately. Damages, under both with and without project conditions, were calculated by the frequency method, using the Econ II program. Agricultural reaches 3, 4, and 5 were found to have distinct first and second bottoms, with entirely different land usage between the two bottoms. These three reaches were evaluated by using a separate damageable value for each bottom. Agricultural damage calculations were based upon information obtained in interviews with owners and operators of flood plain lands. Schedules covered past, present, and intended future use; crop distribution under normal conditions; planting dates; harvesting dates and yields; and historical data on flooding and resultant damages to crops and pastures, as well as to other agricultural property. The land use of the entire flood plain was obtained by field mapping.

Road and bridge damage estimates for without project conditions were based on interviews with county commissioners and data obtained from railroad officials. Estimated benefits were based upon expected reduction in flooding as the result of project installation.

Estimated damages under without project conditions to Dinosaur Valley State Park, now under development, were based on tentative plans for park development which were obtained at a meeting with Texas Parks and Wildlife Department officials. Benefits were calculated on the basis of reduction of stage of flooding as the result of project installation.

An inventory was made of all real property, including value of merchandise stocked by commercial establishments, in order to determine damageable values for the urban area of Glen Rose. Information was collected in the field on

damages experienced from the floods of 1949 and from other floods. At the same time, an evaluation was made of the damages that would occur from a flood which could be expected on the average of once in 100 years. Under without project conditions, a flood of this magnitude would result in high-water elevations in Glen Rose approximately 9 feet higher than the highest water elevations recorded in 1949. High-water marks from the experienced floods were used to determine peak stages, which in turn were related to stages calculated for the evaluation series. Stage damage curves were developed to cover the range of damage producing floods up to the 100-year frequency event. Average annual damages under the present state of development were calculated for sub-reaches within the urban area.

An analysis was made of existing data pertaining to the economic development of the Glen Rose area and of Somervell County. In addition, data developed by the Office of Business Economics (OBE), U. S. Department of Commerce, for Area 08121, which includes the city of Glen Rose, and for Area 08122, which is immediately adjacent to the city of Glen Rose, were analyzed to determine the factors which have contributed to the over-all economic growth of the areas. A comparison of data for both OBE areas to similar data for Glen Rose and Somervell County indicated that the economic growth of Glen Rose is more comparable to Area 08122. Population in Glen Rose has increased at about 93 percent of the historical rate of Area 08122 and is projected to maintain about the same relationship in the future. Further analysis of data available indicates that per capita income in Glen Rose will increase at about the same rate as that projected for the OBE area. For these reasons, it was believed that projections of the total personal income for the OBE area, adjusted for projected population growth rate differences, best reflects the value of properties that would be subject to flood damages, even in the absence of a project. The difference in damage expected to be incurred under both without and with project conditions constitutes the benefit derived from project installation.

The monetary value of the physical damage from flood plain scour and overbank deposition was based upon production lost. The value of recovery from this damage was discounted in accordance with the time required for recovery. The monetary value of streambank erosion damages was estimated by use of procedures outlined in chapter 5 of the Economics Guide. Sediment deposition damage to Lake Whitney was based on average annual capacity lost. Value of storage was based on actual construction costs updated to adjusted normalized prices.

Indirect damages were estimated to approximate 10 percent of direct damages on agricultural property and 20 percent on nonagricultural property.

Benefits from inclusion of municipal water storage in one of the structures were based on estimated costs, as provided by consulting engineers, for constructing a reservoir for that purpose in the same general vicinity as an alternate source of water.

Irrigation benefits were based upon increased net return from improved pasture as the result of supplemental irrigation of this acreage. Associated costs for development of irrigation systems and additional inputs for increased production were deducted from the gross value of benefits.

Intensification of land use benefits were calculated for the acreage of common pasture expected to be managed more intensively as a result of project installation.

Incidental recreation benefits were evaluated for sediment pools of floodwater retarding structures. The estimate of an average annual use of 15,500 visitor-days was based on experience in nearby watersheds, the upward trend in the purchase of hunting and fishing licenses, and the continued increase in expenditures for sporting equipment of all kinds throughout this country. A value of $1 per visitor-day was used for evaluation in accordance with recommendations in Watersheds Memorandum-57, October 3, 1962. Associated costs of development, including liability insurance, operations and maintenance, were deducted from the gross value of benefits. Benefits were calculated allowing for full level of use for 40 years, with a gradual diminishing of use and attractiveness during the next 10 years to zero by the end of 50 years and thereafter.

Secondary benefits were estimated by an adaptation of interdependence coefficients of appropriate agricultural and industrial sectors as calculated in the Input-Output Model of the North Central Region of Texas, which was developed as part of the Texas Interindustry Project, Office of the Governor, Division of Planning Coordination, April 1972.

The value of easements was determined by local appraisal, giving full consideration to current real estate market values.

A comparison of the value of agricultural production lost in the pool areas as a result of the project to the amortized value of the easements showed the latter to be greater. The value of easements was, therefore, used in the economic evaluation.

Fish and Wildlife Resource Investigations

The Bureau of Sport Fisheries and Wildlife, in cooperation with the Texas Parks and Wildlife Department, has completed a reconnaissance survey of the Paluxy River watershed. This report was invaluable in the planning and in the writing of the various portions of this work plan dealing with wildlife and its habitat.

The following recommendation are reproduced from the report:

The watershed is in a region of high recreation demand. Within a 75-mile radius of the watershed's center are located the Dallas-Fort Worth metropolitan area and five cities with a population of 15,000 or more people. The demand for recreation from those cities, coupled with the watershed's Dinosaur Tracks State Park and the natural beauty of the basin, could produce large economic returns from public recreation developments in the watershed. Whitney Reservoir near Meridian, Texas, and DeCordova Bend Reservoir near Granbury, Texas, may compete with the watershed project's recreation potential. However, unsatisfied fishing and hunting demands would be large enough to make the implementation of a project recreation plan a definite asset to the watershed.

There are several ways in which the project plans could be modified to aid fish and wildlife habitats, populations, and harvests.

The floodwater retarding structures near the communities of Glen Rose and Morgan Mill should be expanded to include recreation storage. Also, floodwater retarding reservoirs and farm ponds could be opened to the public for moderately priced fee fishing.

Landowners and the project sponsors should consult the Texas Parks and Wildlife Department regarding the fish stocking requirements of the new waters created by the project. Such consultation would discourage the introduction of undesirable fish species into the project's waters and would insure the best fish stocking rate.

If native grasses or forbs are planted in the basin of the sediment pools prior to inundation, the water fertility would be increased and its turbidity decreased. Vegetation planted on the barren areas draining into the reservoirs also would improve fertility and reduce turbidity.

The control of livestock entering into the area in and around the reservoir sediment pools would reduce fouling of the water and aid the growth of wildlife food and cover plants. When practicable, the sediment pools should be fenced and livestock water requirements supplied by providing water lanes to the pools.

Land treatment measures which would aid wildlife include wildlife habitat development and preservation, field border planting, and hedgerow planting. The deer population on the Cross Timbers Land Resource Area in the watershed is low because of a reduced winter food supply. It could be increased by planting small grain winter crops or legumes, a practice which could be included under the land treatment measures of pasture and hayland planting, range seeding, and conservation cropping systems.

In areas where brush control is done, it should be carried out with wildlife habitat preservation and enhancement in mind. For example, steep easily eroded hillsides should not be cleared. On rolling or flat areas, brush could be controlled by alternating

cleared strips with brush strips at least 100 yards wide. In addition, wildlife escape corridors of brush could be preserved, and some trees could be half-cut and pushed over. In general, about one-fourth of the area's existing brush should be retained as scattered tracts.

Some areas of particular value to wildlife should receive little or no brush control treatment. It is important that the virgin juniper thickts at the south edge of the watershed be preserved to the maximum extent practicable. However, if landowners must remove some junipers there, the removal should be carried out so as to avoid eliminating the golden-cheeked warbler nesting habitat. A little selective clearing can be done in the virgin juniper thickets, but it should be carried out according to a plan mutually agreed upon by the project sponsors, the Soil Conservation Service, and the Texas Parks and Wildlife Department.

Losses of brush and timber resulting from the installation of project measures could be partly offset by planting shrubs and trees at appropriate locations such as idle lands, eroded areas, streambanks, gullies, along fencerows, and around floodwater retarding reservoirs.

With improved wildlife habitat in the watershed moderately priced lease hunting could be expanded. In addition, progressive landowners could form a hunting and fishing cooperative and urban sportsmen could be sold annual permits entitling them to pursue their sport on lands owned by the cooperative members.

All of the foregoing procedures, if accompanied by an aggressive advertising campaign, will satisfy much of the current and future demand for outdoor recreation in the watershed.

In view of the above, it is recommended that:

1. Landowners seek the advice of the Texas Parks and Wildlife Department in the management and stocking of their reservoirs for fish and the management of those waters for wildlife.

2. Native grasses or forbs be planted on barren areas of the sediment pools and on unvegetated areas draining into the subbasins.

3. The sediment pool of the floodwater retarding reservoirs be fenced, when practicable, and livestock water requirements be supplied by providing water lanes to the pools.

4. The land treatment measures of wildlife habitat development, wildlife habitat preservation, field border planting, and hedgerow planting be included in the watershed work plan.

5. The practice of planting small-grain winter crops or legumes be included under the land treatment measures of pasture and hayland planting, range seeding, and conservation cropping systems, on the Cross Timbers land in the watershed.

6. Brush control be done so as to preserve or enhance wildlife habitat by maintaining the brush on easily eroded hillsides, by alternating cleared strips with brushy strips at least 100 yards wide, by preserving escape corridors of brush for wildlife, by half-cutting some trees, and by retaining about one-fourth of the watershed's existing brush as scattered tracts.

7. Any brush control done in the virgin juniper thickets at the south edge of the watershed, be carried out only according to a management plan mutually agreed upon by the project sponsors, the Soil Conservation Service, and the Texas Parks and Wildlife Department.

8. Losses of woody vegetation due to the building of project structural measures be compensated for by planting trees and shrubs suitable for wildlife at appropriate locations such as idle lands, eroded areas, streambanks, along fencerows, and around reservoirs.

9. Landowners consider the feasibility of forming a hunting and fishing cooperative, whereby members would sell annual hunter and fisherman permits which would allow entrance onto cooperative lands.

The above recommendations are in conformance with the U.S.D.A. Soil Conservation Service Plant Sciences Memorandum-5, National Standards and Guides to Specifications for Conservation Practices in the Plant Sciences. If adopted as a part of the plan of development, losses of wildlife habitat would be mitigated and, additionally, fish and wildlife benefits would accrue to the project.

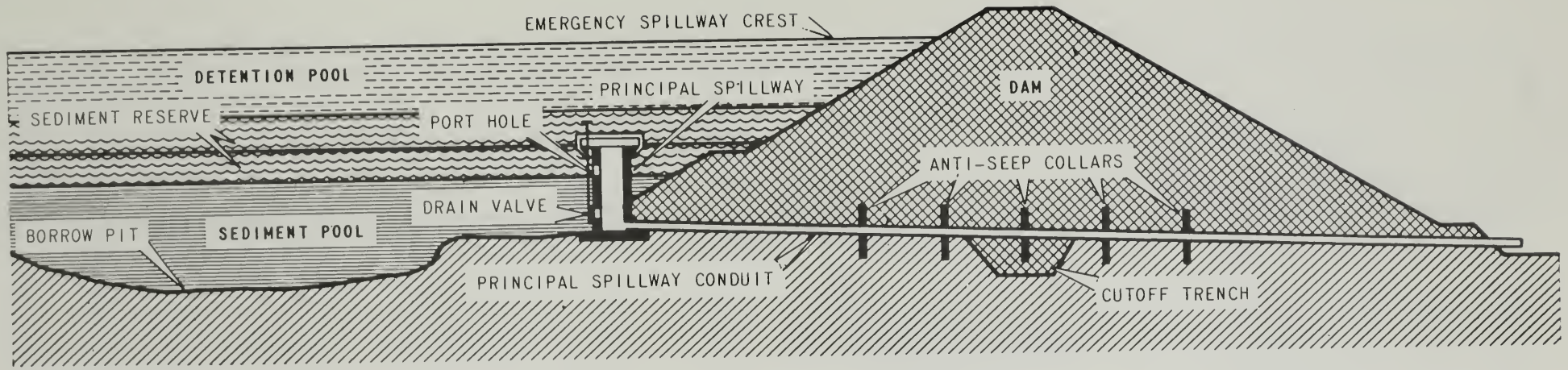
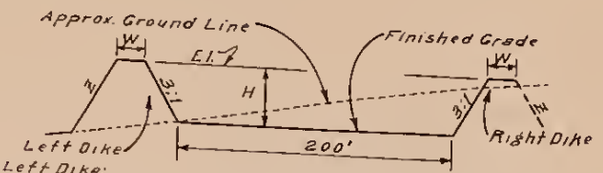


Figure 1

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Rev. 3-65 4-L-10,071



Left Dike:
From Sta. 4+30 to Sta. 5+00-El.=1962.2, W=16.0', Z=2.5:1
From Sta 5+00 to Sta. 5+50 - a transition section.
From Sta. 5+50 to approx. Sta. 6+30-W=10.0', Z=3:1, H=4.5'.
Right Dike:
From Sta. 4+30 to Sta. 5+00-El.=1962.2, W=16.0', Z=2.5:1
From Sta. 5+00 to Sta. 5+50 - transition to W=10.0', Z=3:1, H=4.5'
Material forming dikes shall be placed and paid as "Earth Fill, Embankment".

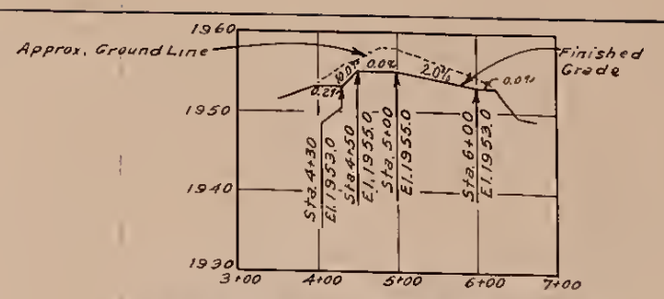
TYPICAL SECTION — EMERGENCY SPILLWAY

Emergency Spillway Diversions and Stub Diversions (S.D.): 18" effective height, 3:1 side slopes and 13 ft., minimum base, shall be constructed at the approximate locations shown on the plans. Final locations of the Stub Divarsions shall be determined by the Engineer (See Construction Specification 5).

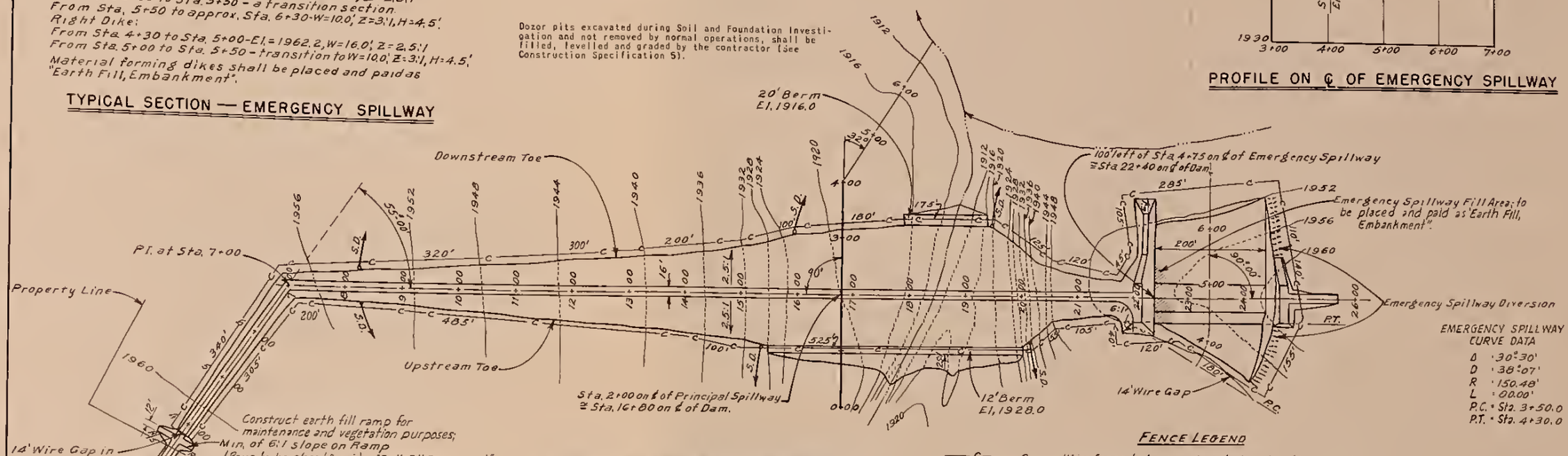
A minimum of 6" topsoil shall be placed in Emergency Spillway and on all Earth Fill Areas (See Construction Specification 20C).

Stream Channal within embankment area shall be shaped and cleared of objactionable material (see sheet 12 and Construction Specification 4).

Dozor pits excavated during Soil and Foundation Investigation and not removed by normal operations, shall be filled, levelled and graded by the contractor (See Construction Specification 5).



PROFILE ON ℄ OF EMERGENCY SPILLWAY



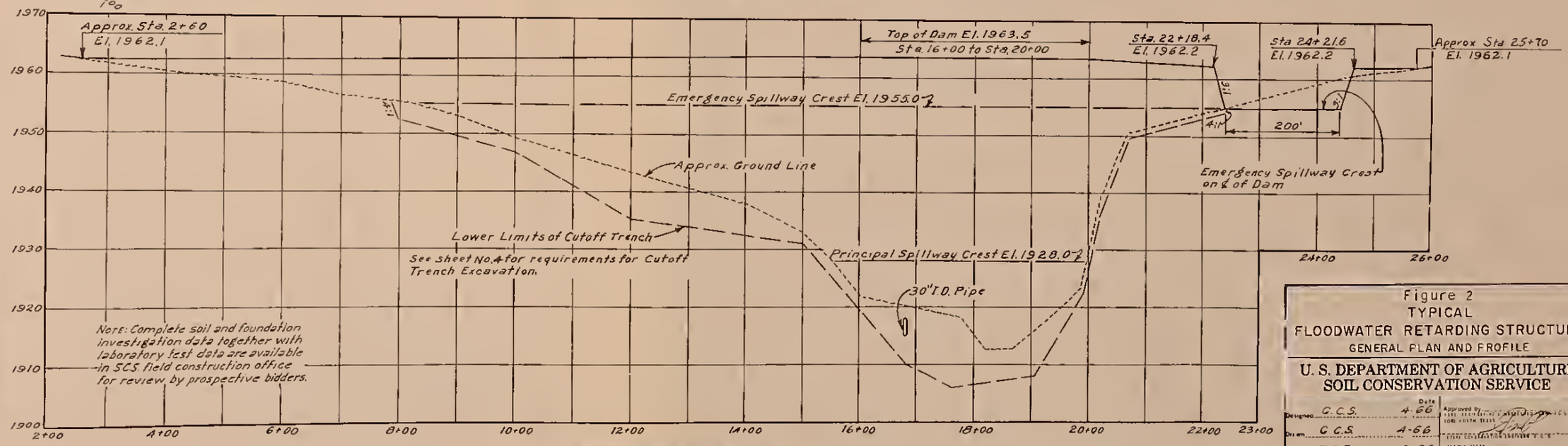
EMERGENCY SPILLWAY CURVE DATA
Δ = 30°30'
D = 38°07'
R = 150.48'
L = 00.00'
P.C. = Sta. 3+50.0
P.T. = Sta. 4+30.0

PLAN OF EMBANKMENT AND SPILLWAYS

0 100 200 300 400 500
SCALE IN FEET

FENCE LEGEND

—C—C— Wire fence to be constructed under this contract
—F/S—F/S— Fence in construction area to be removed and salvaged by the Contractor.



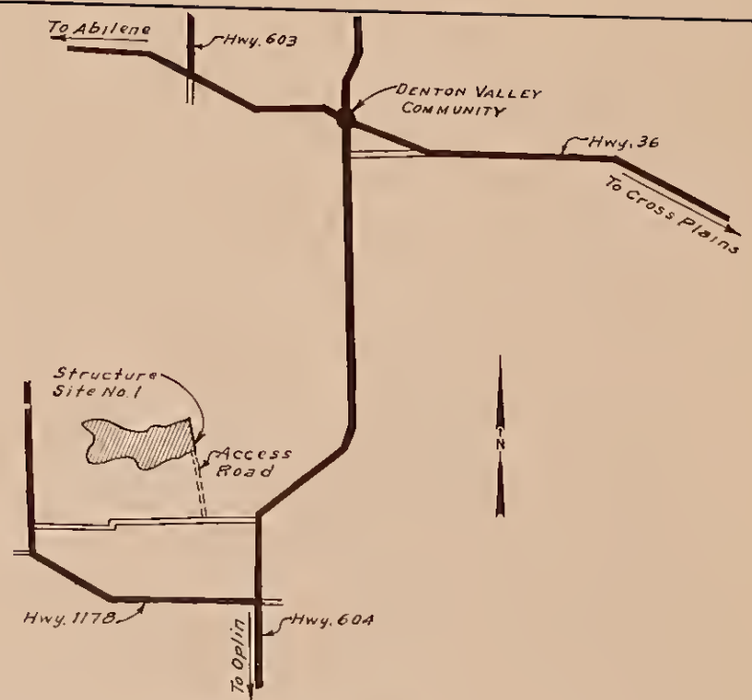
PROFILE ON ℄ OF DAM

Figure 2
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	C.C.S.	4-66
Drawn	C.C.S.	4-66
Traced	T.F.R.	5-66
Checked	G.C.S.	5-66

Approved by [illegible]
Sheet No. 2 of 13
Drawing No. 4-E-21,594



Structure site is located approx. 7 miles southwest of Denton Valley Community, Callahan County, Texas.

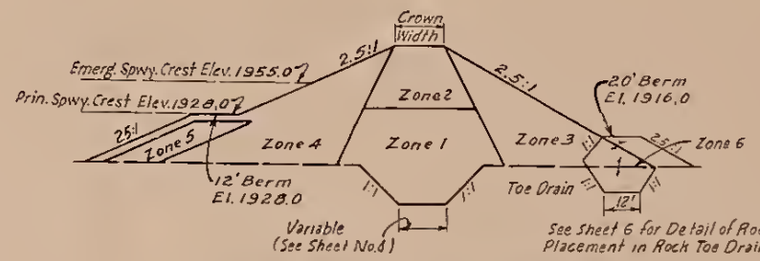
VICINITY MAP

0 1 2 3 4
SCALE IN MILES

Note: For limits of clearing and clearing and grubbing see Construction Specifications 1 and 2.

GENERAL PLAN OF RESERVOIR

0 660 1320 1980 2640
SCALE IN FEET



TYPICAL SECTION - ZONED EMBANKMENT

MATERIALS PLACEMENT DATA

Embankment Zone No. 1/	Source of Fill Materials: Material Location 2/	Average Depth, feet: From	To	Type or Unified Classification	Field Control Test: ASTM Test Number	Method	Placement and Compaction Requirements: Max. Allowable Particle Size	Max. Uncompacted Layer Thickness	Specified Compaction Class	Min. Dry Density, Percent of Field Test Max. Dry Density	Moisture Limits, Relative to Field Test Optimum: From	To	Laboratory Test Data: ASTM Test Number	Method	Curve No.	Max. Dry Density, p.c.f.	Optimum Moisture, %
1	Borrow	0	3	CL	D698	A or B	6"	9"	A	95	-2	+4	D698	A	5	101.5	20.5
	Borrow	0	6	CL	D698	A or B	6"	9"	A	95	-2	+3	D698	A	6	113.0	14.0
	Borrow	0	4	SC	D698	A or B	6"	9"	A	95	-1	+3	D698	A	3	116.5	13.0
2 & 3	Borrow	4	12	GC	D698	D	6"	9"	A	95	Opt.	+4	D698	C	2	130.0	7.0
4	Borrow	0	7	SM	D698	A or B	6"	9"	A	95	-1	+4	D698	A	4	121.5	11.0
5	Borrow	0	4	SM	D698	A or B	6"	9"	A	95	Opt.	-4	D698	A	1	116.0	11.5
2 & 3	Emerg. Spwy.	0	Grade	GC	D698	D	6"	9"	A	95	Opt.	4	Not Tested				
6	3/	Durable Rock					24"	36"									

1/ The zone boundaries shown in the typical section are approximate. Adjustments will be made by the Engineer to permit the use, within the neat lines of the embankment, of all suitable materials from the required excavations.

2/ Materials from the required excavations that are not tabulated in the table above and that are suitable and acceptable for earth fill shall have the same placement and control requirements as that specified for like materials under Materials Placement Data.

3/ Rock Material to be used for the Rock Toe Drain, Berm, and Channel liner shall be procured from required excavations.

Additional rock materials required in excess of that obtained from specified excavations shall be combed, raked or otherwise harvested from the sediment pool, detention pool, or surrounding areas. (See Construction Specification 5).

ZONED EMBANKMENT DATA

All usable material from within the sediment pool shall be used prior to enlarging borrow area outside these limits. Borrow from outside the sediment pool shall be obtained only as directed by the Engineer.

Elevation	Surface Acres	Storage: Acre Feet	Inches
1918	1	3	.0
1920	3	11	.02
1924	9	35	.05
1928	13	79	.12
1932	22	149	.23
1934.1	27	207	.32
1936	32	257	.40
1940	47	415	.65
1944	71	651	1.01
1948	96	985	1.53
1952	130	1437	2.24
1955	155	1864	2.90
1956	163	2023	3.15
1960	197	2743	4.27
1962.1	221	3182	4.95
1964	243	3623	5.64

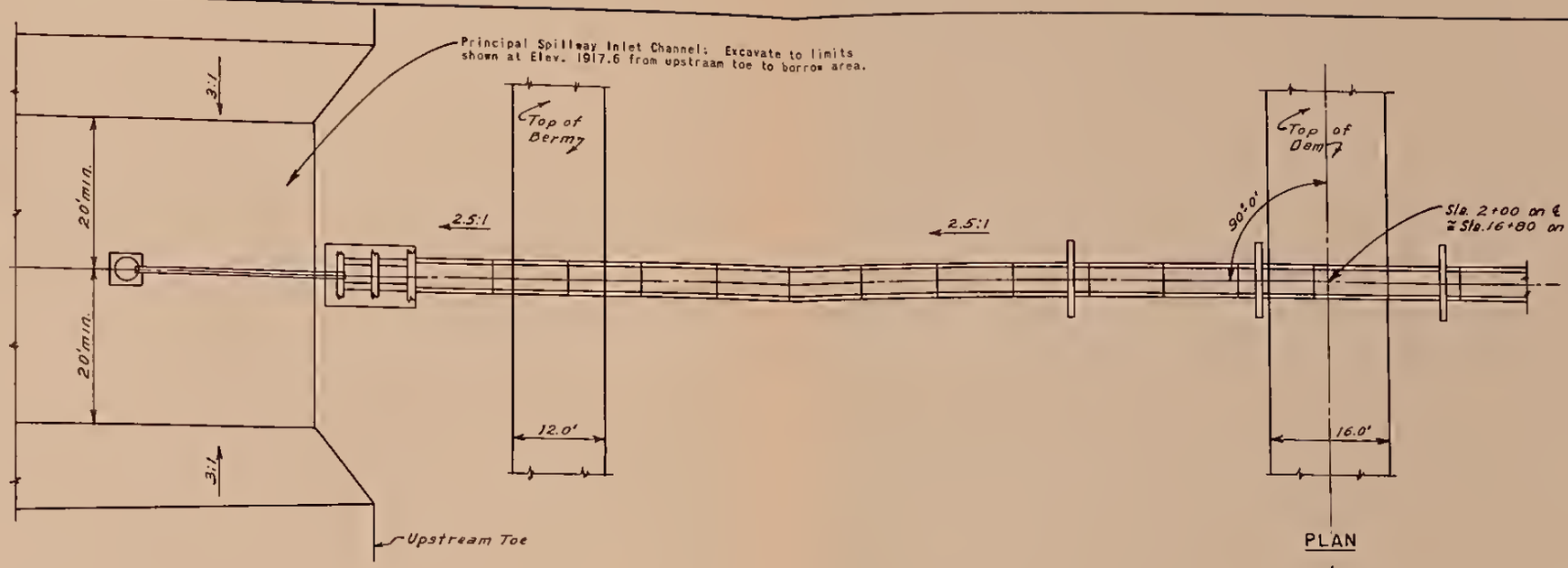
Top of Dam (Effective) Elev.	1962.1
Emergency Spillway Crest Elev.	1955.0
Principal Spillway Crest Elev.	1928.0
Sediment Pool Elev.	1928.0
Drainage Area, Acres	1706.
Sediment Storage, Acre Feet	207.
Floodwater Storage, Acre Feet	1657.
Max. Emergency Spillway Cap., c.f.s.	10,820.

Figure 2
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

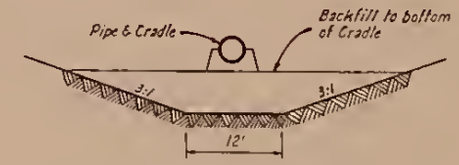
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	G.C.S.	4-66
Drawn	G.C.S.	4-66
Traced	T.F.R.	5-66
Checked	G.C.S.	5-66

Approved by: [illegible] STATE CONSERVATIONIST
Sheet No. 3 of 13
Drawing No. 4-E-21,594



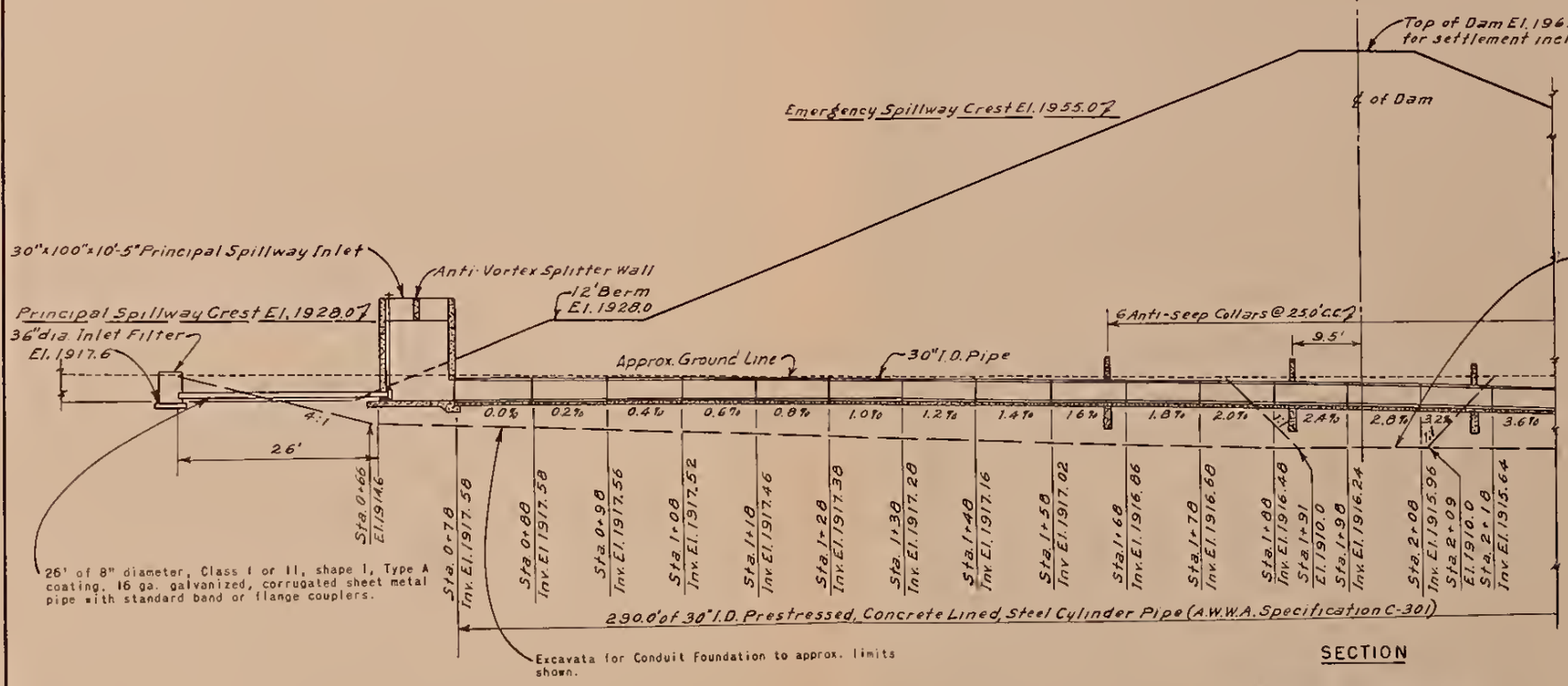
PLAN



Excavation to be paid as "Excavation, Unclassified".

Prior to placing backfill around the structure, the surface layer of the in-place fill material shall be reworked as necessary, and to the depth necessary, to restore and satisfy the density and moisture requirements specified for that fill material.

TYPICAL CONDUIT FOUNDATION EXCAVATION



Excavate Cutoff Trench with 1:1 side slopes and 18 ft. bottom width to approximate limit shown on "Profile on Centerline of Dam" from Sta. 8+00 to approximate Sta. 19+75.

Remove all of the slide rock, boulders, flags, cobbles, common and organic material to hard unfragmanted rock in preparation for base of dam on tha right abutment, approx. Sta. 19 75 to Sta. 22 40. Remove tha right abutment scarp and slope to not steeper than 2 horizontal to 1 vertical. (See Construction Spec. 4).

SECTION

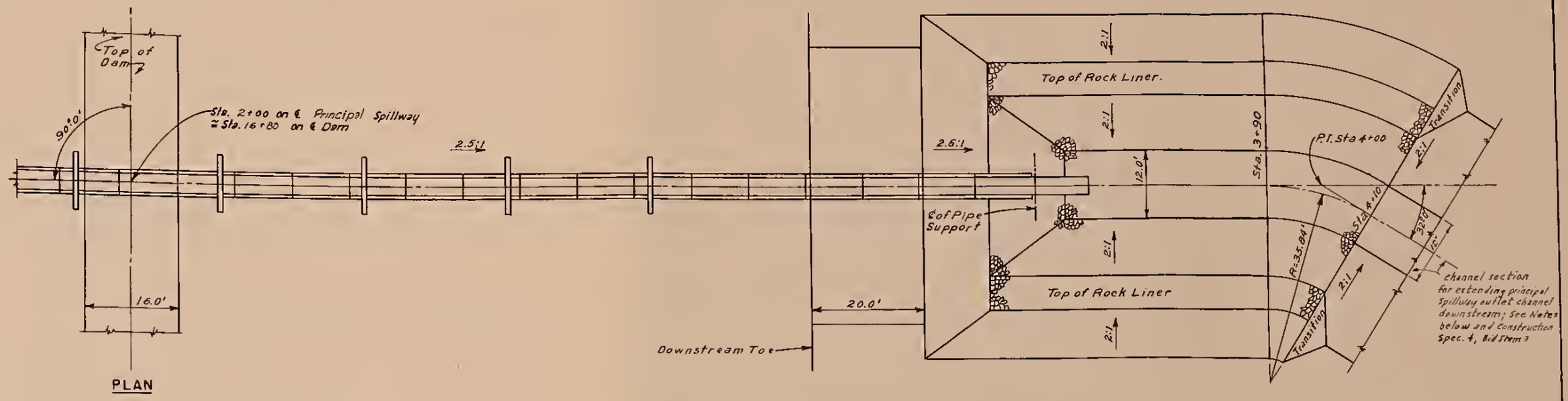
PRINCIPAL SPILLWAY

Figure 2A
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

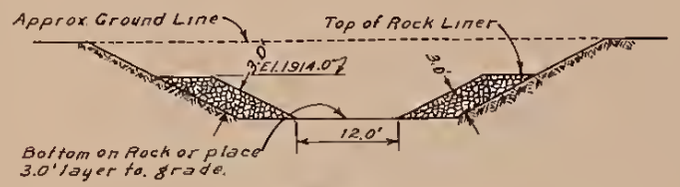
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	G.C.S.	4-66	Approved by ...
Drawn	G.C.S.	4-66	
Traced	T.F.R.	5-66	
Checked	G.C.S.	5-66	Sheet No. 4 of 13

Drawing No. 4-E-21,594



PLAN



SECTION

NOTE: Excavation for the Rock lined Channel shall be paid as "Excavation, Unclassified". Place a 3.0 ft. thickness of dumped rock to dimensions shown in the drawings with rock size grading from small at subgrade to large at finished grade. Placement of spalls and cobbles shall precede dumping of boulders. Rock material shall be placed to reasonably neat lines of the finished grade. Payment for placing rock fill in channel is not a separate item; such cost shall be considered "Earth Fill, Embankment" and paid for as such. Rock against Principal Spillway shall be placed so as to avoid damage to pipe and other structural works. See sheet 3 for sources of Rock Material.

SECTION

PRINCIPAL SPILLWAY

Figure 2A
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	G.C.S.	4-66
Drawn	G.C.S.	4-66
Traced	T.F.R.	5-66
Checked	G.C.S.	5-66

Approved by: ... SOIL CONSERVATION SERVICE, U.S.D.A. ... TEMPE, TEXAS

Sheet No. 5 of 13

Drawing No. 4-E-21,594

LEGEND

- Roads
- Railroad
- Pipeline
- Transmission Line
- County Line
- Towns and Communities
- Cemetery
- Drainage
- Watershed Boundary
- Outside of Project Area
- LWC — Low Water Crossing
- Outline of Floodwater and Sediment Damage Area
- 101 — Valley Cross Section
- R-1 — Evaluation Reach
- SSSSSSSSS Scour Damage
- +++++++ Overbank Deposition Damage
- Streambank Erosion
- Virgin Ashe Juniper Area
- City Limits

PALUXY RIVER WATERSHED
TEXAS

Polyconic Projection

Approx. Scale
1 192,000

Figure 3

PROBLEM LOCATION MAP

PALUXY RIVER WATERSHED
Erath, Hood and Somervell Counties, Texas

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Temple, Texas

Approximate Drainage Area 249,920 Acres

Rev. 12-70 4-R-28629

Rev. 11-69 4-R-20625

Base from General Highway Map — Rev. 1967 — Reproduction permission granted U.S. Department of Agriculture, Soil Conservation Service, Fort Worth, Texas.
USDA-SCS-FORT WORTH, TEX. 1970

Figure 4

URBAN AREA
GLEN ROSE, TEXAS
PALUXY RIVER WATERSHED

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TEMPLE, TEXAS

Uncontrolled mosaic from 1966 photos

Scale: 1" = 660'

Rev. 12-70 4-R-28779
Base 4-R-28320

July 1969

USDA SCS-FORT WORTH, TEX 1970

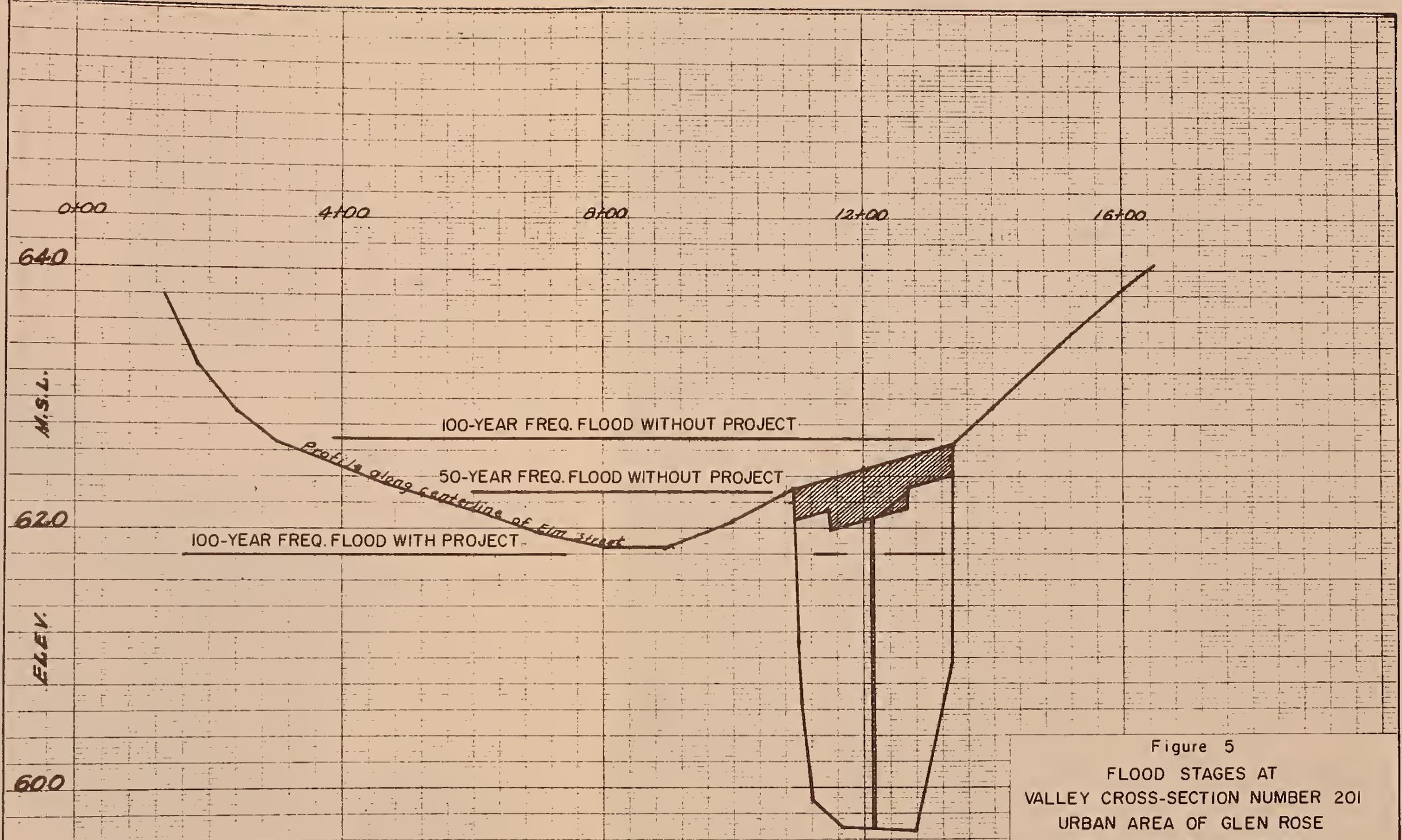


Figure 5

FLOOD STAGES AT
VALLEY CROSS-SECTION NUMBER 201
URBAN AREA OF GLEN ROSE
PALUXY RIVER WATERSHED

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

Rev. 12-70 4-R-28,633

LEGEND

- Roads
- Railroad
- Pipeline
- Transmission Line
- County Line
- Towns and Communities
- Cemetery
- Drainage
- Watershed Boundary
- Outside of Project Area
- Floodwater Retarding Structure
- Multiple Purpose Structure (M-Municipal)(I-Irrigation)
- (5) Site Number
- Drainage Area Controlled by Structure
- Area Benefited
- LWC Low Water Crossing
- City Limits

PALUXY RIVER WATERSHED
TEXAS

98° 10′ 98° 05′ 98° 00′ 97° 55′ 97° 50′ 97° 45′
32° 25′ 32° 20′ 32° 15′ 32° 10′

SITE NUMBERS AND DRAINAGE AREA IN ACRES

Number	Acres	Number	Acres
1	2,496	14	2,502
2	1,958	15	7,878
3	1,536	16	3,117
4	1,350	17	13,190
5	2,778	18	14,720
6	3,098	19	7,270
7	7,642	20	11,450
8	1,293	21	9,997
9	1,946	22	10,470
10	1,286	23	2,970
11	890	24	4,026
12	2,886	25	7,322
13	7,680	26	8,525

Polyconic Projection

Approx. Scale 1:192,000

Figure 6

PROJECT MAP
PALUXY RIVER WATERSHED
Erath, Hood and Somervell Counties, Texas

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Temple, Texas

Approximate Drainage Area 249,920 Acres

Rev. 12-70 4-R-28630

Base from General Highway Map — Rev. 1967 — Reproduction permission granted U.S. Department of Agriculture, Soil Conservation Service, Fort Worth, Texas.
USDA-SCS-FORT WORTH, TEX 1970

Rev. 11-69 4-R-20625